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# ANNUAL REPORTS

OF THE

# DEPARTMENT OF AGRICULTURE

FOR THE

FISCAL YEAR ENDED JUNE 30, 1906.

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REPORT OF THE  
SECRETARY OF AGRICULTURE.  
DEPARTMENTAL REPORTS.

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REPORT OF THE SECRETARY OF AGRICULTURE.

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# REPORT

OF THE

## SECRETARY OF AGRICULTURE.

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MR. PRESIDENT:

In presenting my Tenth Annual Report of the work of the Department of Agriculture, the position of the producer from the soil in the development of our country is indicated.

It will be seen that he is making progress in the sciences and arts of agriculture; that the researches of the Department and of the experiment stations are enabling him to meet the requirements of a growing population for larger quantities of field products; that the time of the man and the yield of the acre become more responsive as more imperative demands are made upon them; that our research extends to all the States and Territories and to our island possessions; that every feature of interest in soils, plants, and animals has due attention; that explorations during the past year in extreme northern latitudes of Europe and Asia have resulted in accessions of plants suitable to our dry regions that promise to help in bringing them into profitable production.

The laws made by Congress at its last session to be put into execution by the Department have required and have received special attention. The meat law is being enforced with but little friction. At this time inspection is made in about 1,000 houses, and about 1,300 experts have been added to the inspection force of the Bureau of Animal Industry.

Rules have been made, as required by Congress, for the execution of the pure-food law, and hearings are being given to parties interested. The law regarding the extermination of the cattle fever tick (*Boophilus annulatus*) of the Southern States is being put in force and good results are following. Progress is being made in dealing with the gipsy and brown-tail moths in New England, imported parasites being successfully established. A beginning has been made in determining correct rules for grading grain and acquiring facts regarding methods of handling it in its movement toward the market.

The law providing for the humane treatment of live stock in transit is receiving careful consideration, and violations will be reported to the Department of Justice.

### REVIEW OF PRODUCTION.

#### NATIONAL DEPENDENCE ON AGRICULTURE.

Economic revolution in the art and science of agriculture, which became noticeable in this country half a dozen years ago, has continued during 1906, with tremendous effect upon the nation's prosperity.

Crops so large as to be beyond any rational comprehension have strained the freight-carrying ability of railroads. Directly and indirectly the farmer has set up a demand for iron and steel that has



exceeded the productive power of the chief producer among nations. His contribution to the supply of loan capital has been beyond calculation and recalls the fact that the depression in the loan and investment market of 1903 was cleared away by the following crop.

Meanwhile the farmer has been a generous consumer, and has given powerful support to the market of the industrial producer, to the trade of the merchant, and to the wages of the workingman.

The farmer has become aware of the importance of the place that he occupies in the Republic, and in the pride of his occupation he is ready to offer this yearly account of himself to the people.

Preliminary crop estimates, subject to modification, must be used in the following review of the year's farm production, in advance of the final estimates of the Department, to be made a little later. The estimate of total agricultural wealth production has been continued from previous years and is again presented as an indication of the financial results of the year's operations. All attempts in the past, by subtracting from this grand total of value such products as are used wholly or in part in the making of other farm products in order that the farmer's net wealth production might be ascertained, have given no indication of what that net production was, and have only obscured the matter.

#### TOTAL WEALTH PRODUCED.

Taken at that point in production at which they acquire commercial value, the farm products of the year, estimated for every detail presented by the census, have a farm value of \$6,794,000,000. This is \$485,000,000 above the value of 1905, \$635,000,000 above 1904, \$877,000,000 above 1903, and \$2,077,000,000 above the census for 1899.

The value of the farm products of 1906 was 8 per cent greater than that of 1905, 10 per cent over 1904, 15 per cent over 1903, and 44 per cent over 1899.

A simple series of index numbers is readily constructed, which shows the progressive movement of wealth production by the farmer. The value of the products of 1899 being taken at 100, the value for 1903 stands at 125, for 1904 at 131, for 1905 at 134, and for 1906 at 144.

#### GAINS AND LOSSES.

Analysis into items of the grand total of wealth produced discovers that most of the increase over 1905 is due to horses and meat animals, and this is so partly because of the Department's much increased estimate of the number of these animals last January, and more largely because of higher prices than a year ago.

The price of milk ran higher than in 1905, but the value thus gained in wealth produced was perhaps more than offset by the lower prices for butter. So, in the case of poultry, the gain in live and dressed poultry was more than balanced by the reduced egg value, since the mean farm price of eggs, as ascertained by this Department, declined from 18.7 cents during 1905 to 17 cents during 1906.

Crops, in a general balance of gain against loss in value, in comparison with the crops of 1905, have made substantial but not large gain—about \$22,000,000; so that the previous foremost year in value of products, 1905, is exceeded by 1906 in both crops and animal products, and thus this year became the leading one in value of farm products in the history of the country by \$485,000,000 over 1905.

On the side of gains over 1905, two short crops are conspicuous; hay leads with a gain of perhaps \$80,000,000 in value, and the oat crop is second, with a gain of possibly \$14,000,000. Barley and cottonseed each promise a gain of \$10,000,000; beet sugar, \$7,000,000; tobacco, \$2,000,000 or more; and hops, \$1,000,000.

Against these gains are the losses of three abundant crops—\$60,000,000, more or less, for wheat, and \$10,000,000 each for corn and potatoes. The loss on rye and cane sugar may be about half a million dollars each, if anything. The net decline for all cereals may be \$40,000,000.

The foregoing gains and losses in value, as well as others not mentioned, are exceedingly uncertain, and are to be regarded only as indicative of a general conclusion.

#### CHIEF CROPS.

**ALL CEREALS.**—While the value of all cereals dropped about \$40,000,000 below the total of 1905, and about \$12,000,000 below the total of 1904, the number of bushels for 1906, which was 4,688,000,000, was 120,000,000 bushels above the yield of 1905, 570,000,000 above the yield of 1904, and 835,000,000 bushels above the yield of 1903.

**CORN** remains by far the most valuable crop, and the figure that it may reach this year is \$1,100,000,000 for 2,881,000,000 bushels—perhaps a little under the value of the next largest crop, that of 1905.

**THE COTTON CROP**, fiber and seed combined, follows corn in order of value, although it is only three-fifths of the value of the corn crop. No comments here must be regarded as indicating what the Department's estimate of the cotton-fiber production is to be. Upon the basis of the general commercial expectation of a crop, it should be worth to the grower nearly \$640,000,000. In Texas alone the cotton crop is greater than that of British India and nearly three times that of Egypt, and it is half as much again as the crop of the world, outside of the United States, India, and Egypt.

**HAY** is a crop that receives small popular attention, and yet it is the third one in value if cotton seed is included in the cotton crop, and this year it approaches \$600,000,000 for a product that is short by perhaps 8,000,000 tons.

**WHEAT.**—The fourth crop in order of value is wheat, which this year may be worth over \$450,000,000, a value that has been exceeded in several years; but in quantity this year's crop, with its 740,000,000 bushels, is only 8,000,000 bushels below the largest crop grown—that of 1901.

**OATS.**—The crop of oats, on account of unfavorable weather, has fallen below the usual amount, but its value will be perhaps not far under \$300,000,000, or about the same as for 1905, and not much under the highest value reached, in 1902.

**POTATOES.**—With a probable crop of fully 300,000,000 bushels potatoes reach next to their highest production, which was in 1904; but the total value, \$150,000,000, rests upon a rather low average per bushel and has been exceeded in other years.

**BARLEY.**—Seventh among the crops in order of value is barley, a cereal that has gained 21 per cent in production in seven years. The 145,000,000 bushels grown this year may be worth \$65,000,000, both bushels and dollars being much more than for the highest preceding years—1904 being the previous record year for yield and 1902 for value.

TOBACCO, which has shown weakness for several years on account of low prices, while not yet recovering its former place in pounds grown, has a crop this year of 629,000,000 pounds, with a value which is in close company with the three years of highest value, and it is expected will be worth \$55,000,000, or perhaps \$2,000,000 more.

SUGAR.—A remarkable development has been made within a few years by now the ninth crop—beet sugar. The production in 1906 is placed at 345,000 long tons, with a value supposed to be near \$34,000,000. Seven years ago only 72,972 tons were produced, and their value was about \$7,000,000.

The year was a rather bad one for cane sugar, but in spite of this the total production of beet and cane sugar slightly exceeded the highest previous figure, although in value of sugar the year stands second. The value of all kinds of sugar, sirup, and molasses reaches a total of \$75,000,000, second only to 1904, which was cane sugar's best year.

FLAXSEED.—The 27,000,000 bushels of flaxseed have been exceeded by three years, although the value, \$25,000,000, reaches the highest point.

RICE, standing twelfth in order, is another crop with its highest value, perhaps \$18,000,000, although in production the 770,000,000 pounds of rough rice are second to 1904. Markets that have developed in Hawaii and Porto Rico have helped to keep the price high enough to account for the total value placed upon the crop.

RYE has become a minor crop and has now fallen below rice in value. The crop of this year is below the larger crops of recent years, and is about 28,000,000 bushels, worth perhaps \$17,000,000.

HOPS.—The fourteenth crop is hops, which reached its largest dimensions this year with 56,000,000 pounds, and as high a value as it ever had, except in 1904, say, \$7,000,000.

SUMMARY.—On the whole, crop values have been neither notably high nor low in comparison with recent years, but the crops are so many in number that losses meet gains, and the crops have been on such a high price level in the general average that they have raised the total crop value somewhat above 1905 and the high preceding years. To reach a still higher point in this extraordinary series of high annual values than had been touched before is an achievement that deserves attention.

#### EXPORTS OF FARM PRODUCTS EXCEED FORMER YEARS.

Farm products continue to be so far beyond the national requirements that the farm still overshadows the mill, the factory, and the workshop in providing exports. With his surplus beyond the nation's need, the farmer has loaded the fleets of oceans. These products were exported to the value of \$976,000,000 during the fiscal year ending June 30, 1906—enough to build a high-class railroad halfway around the earth. This is the largest amount ever reached by agricultural exports for this or any other country, and exceeded by \$24,000,000 the extraordinary value of 1901, which had previously been the record year.

#### PRINCIPAL ITEMS.

Principal among the items that make the increase over the fiscal year 1905 are grain and its products, chiefly wheat and flour, for which the gain was \$79,000,000; packing-house products, for which the gain was over \$37,000,000; cotton, \$19,600,000; various seeds,



\$6,355,000; dairy products, \$3,900,000; and live animals, \$2,400,000. Products exhibiting a decrease were mostly inconsiderable. In hops, the decline was \$1,355,000; tobacco, \$992,000; vegetable oils, \$726,000; fruits, \$440,000.

#### HIGHEST VALUE OF COTTON EXPORTS.

Cotton maintains its long lead over other chief exports, with a value of \$401,000,000 for 3,634,000,000 pounds, so that the latest year was exceeded only by 1898, 1899, and 1905 in quantity exported; but in value of exported cotton the figures for 1906 are \$19,600,000 higher than for 1905, which was previously the record year, and \$29,000,000 higher than for 1904, which was third in order in the value of these exports.

In exports of grain and grain products for 1906 the value again reached a high amount and has been exceeded only 13 times in the last fifty-six years. The value of this class of exports last year was almost exactly the average of the preceding twenty-five years.

#### LEADING YEAR FOR PACKING-HOUSE PRODUCTS.

Packing-house products are another class of exports that found their leading year in value in 1906, the amount being \$207,700,000. No previous year had reached \$200,000,000, and only two years had passed \$180,000,000. The value of exported fresh beef, \$24,300,000, was well up to the average of recent years; lard exports to the value of \$60,000,000 and a quantity of 742,000,000 pounds went far beyond the highest figure of preceding years in both respects; bacon took an upward turn with exports valued at \$36,000,000 for 361,000,000 pounds and rose well up toward the higher export years of the past. The level of recent years was reached in the exports of hams, their value being \$20,000,000 and weight 194,000,000 pounds. The highest exports, both in quantity and value, of oleo oil in previous years were far overtopped by the exports of this commodity in 1906, and the 210,000,000 pounds exported were valued at \$17,500,000.

#### IMPORTS OF FARM PRODUCTS.

The imports as well as the exports of agricultural products reached their highest value in 1906, when the amount was \$554,000,000, or less than one-fourth of a million dollars over the value of 1905, which was then the highest record. The principal increases over 1905 in these imports were \$20,000,000 for packing-house products, almost entirely composed of hides, skins, hair, and bristles; \$4,400,000 for tobacco; \$2,700,000 for vegetable fibers; \$1,900,000 each for seeds and vegetable oils; \$1,800,000 for fruits; \$1,200,000 for nuts; and \$1,100,000 for vegetables. On the other hand, there were decreases in imports which nearly balanced the increases, and principal among these were coffee, with a loss of \$11,000,000; sugar and molasses, with a loss of \$12,600,000; wool and silk, with a loss of \$7,000,000 each; and tea, with a loss of \$1,650,000.

The principal imported articles are the same year after year, and among them for 1906 the imports of packing-house products were valued at \$96,000,000; of sugar and molasses, \$86,000,000; of coffee, \$73,000,000; of silk, \$54,000,000; of vegetable fibers, \$50,000,000; of wool, \$39,000,000; of tobacco, \$22,000,000; of fruits, \$21,500,000; of tea, \$14,600,000; and of vegetable oils, \$12,600,000.

## FOREIGN TRADE IN FOREST PRODUCTS.

On account of the increasing value of forest products, the exports of these commodities in 1906 reached a considerably higher figure than ever before, with a value of \$77,000,000, or \$13,748,000 more than in 1905. The imports of these products also increased in value by \$3,000,000; all items exhibit an increase except india rubber, the imports of which declined by \$4,800,000. In total value the imports of forest products were \$95,700,000 in 1906, an amount far above that of any preceding year except 1905.

## BALANCE OF TRADE.

The so-called balance of trade in the international exchange of agricultural commodities continues to run in favor of this country by an enormous amount; for 1906 the agricultural exports exceeded similar imports by \$433,000,000, an amount which places this year with the seven high years beginning with 1898 and much above the balance of 1905. This new foreign credit, which equaled that of a rich nation, was mostly offset by large borrowings in this country from Europe for the purpose of enlarging railroad and other capital.

While the farmer placed to the National credit in other countries \$433,000,000 in 1906, other producers, all included, secured a balance in favor of this country of only \$85,000,000. During the last seventeen years the farmer has built up a balance of trade in foreign exchange of agricultural products amounting to \$6,068,000,000, while all other producers find themselves at the end of the same period with a total on the debtor side of the account to the extent of \$459,000,000.

## INCREASE OF FARMING CAPITAL.

Having produced fabulous wealth during the year and having sent to foreign countries out of the wealth of the preceding year enough to pay the interest-bearing national debt, the farmer may now take account of his farming capital. The large rate of increase in its value since 1900 is not a mere matter of a higher price level and higher land values. In the meantime the farmer has earned a surplus income, much of which he has invested in his farming equipment, in buildings, in many improvements, in live stock, in machinery, and in furtherance of the comforts and pleasures of living.

## REAL ESTATE AND FARM EQUIPMENT.

The farm real estate, as ascertained by this Department last year, increased in value \$6,131,000,000 since the census year, or enough to raise the census value to \$22,745,000,000. Domestic animals were worth \$2,979,000,000, according to the census enumerators, and now they are estimated to be worth more than \$4,000,000,000. There has been a very active demand for implements and machinery, not only by farmers who have become financially able for the first time to buy, as in the South, but by farmers already provided with them, who have needed to reduce their dependence upon human labor by getting more servicable machines.

If real estate, domestic animals, other live stock, and implements and machinery are combined, the farmers' capital, as composed of these items, has increased by perhaps \$8,000,000,000 since the census valuation, or about 40 per cent, and now amounts to perhaps \$28,000,000,000.

## DOMESTIC ANIMALS.

The domestic animals of the farm number about 200,000,000 at the time for which it is estimated by the Department, which is January 1. Strictly beef cattle, sheep, and swine are each one-fourth of the total, and dairy cows and draft animals each about one-tenth. The value of these animals has increased during the year, and only a very rough estimate can now say how much, in advance of the careful estimate to be made in January. Perhaps the gain is about \$400,000,000; at any rate, the increase seems to be as much as 10 per cent.

## MEAT SUPPLY.

## NUMBER OF ANIMALS SLAUGHTERED.

Upon the farmers' vast herds of meat animals the nation depends for its most expensive class of foods in various kinds of meat and for one-third of its dietary. The figures of meat production, which are the result of a recent large and searching investigation by this Department, strikingly express the magnitude of the farmer's occupation, as evidenced by only one of its branches, and the largeness of its performance in national sustenance and exports.

In the last census year, 1900, 93,502,000 meat animals were slaughtered and exported, and of these 18,809,000 were cattle, including calves; 24,548,000 were sheep, including lambs; and over one-half, or 50,145,000, were hogs. Every time the clock ticks a second during ten hours of a workday the farmer drives nine meat animals to the butcher.

## POUNDS OF MEAT PRODUCED.

The meat production of 1900, in terms of dressed weight and weight of edible parts not included in dressed weight, was 19,186,330,000 pounds, of which 2,433,035,000 pounds, or 12.68 per cent, were exported, so that the national consumption was 16,753,295,000 pounds.

Such great numbers may be better understood if they are reduced to the average of the census private family, 4.6 persons. To such a family in 1900 the farmer supplied 49 pounds of veal, 431 pounds of beef, 30 pounds of lamb, 39 pounds of mutton, and 465 pounds of pork, including lard, or, in all, 1,014 pounds of meat, amounting to half a ton.

If the exports had been consumed at home, they would have given to each family more beef than the foregoing by 50 pounds, more pork by 97 pounds, or together 147 pounds.

In the consumption of meat, expressed in terms of entire animals, each family asks the farmer for over one-third of a calf, over two-thirds of a steer or cow, over three-fourths of a lamb, nearly three-fourths of a sheep, and two and one-half hogs, and the farmer responds so liberally that one-eighth of his supply is left over for the foreigner. It is upon the selling of this surplus in foreign countries that the farmer depends for the maintenance of profitable prices for his meat animals.

## LARGE PLACE OF THE SURPLUS IN THE WORLD'S TRADE.

This fraction of one-eighth is small, but it becomes remarkably magnified when it crosses the Atlantic Ocean. The national surplus of meat for one year, if composed of the different kinds as actually



used in consumption, is sufficient to feed either the United Kingdom or the German Empire for nearly half a year, or both for nearly one-fourth of a year, and the population of these two countries in 1901 was 98,000,000, as compared with a population of 76,000,000 in this country the year before.

This little fraction of the national product of meat which goes to other countries looks large when viewed in another aspect. In the world's international trade in packing-house products and live meat animals the place occupied by the exports from the United States is indicated by about 40 per cent of the total value.

#### IMPORTANCE OF SWINE.

As a meat producer, the importance of the hog appears in the foregoing statement. The yearly turnover or slaughter of hogs is equal to about four-fifths of the number on hand June 1, and the meat, including lard, produced in 1900 was 9,279,583.000 pounds, or more than half a billion pounds over the 8,771,263,000 pounds of veal and beef, and over eight times the 1,135,484,000 pounds of lamb and mutton.

In one State alone, Iowa, the pork products for 1906, including lard, are equivalent in pounds to nearly the entire exports of the meat products of swine in 1900. Should Iowa suddenly lose its swine, for the time being exports of their products must substantially cease or the home consumption of them be reduced one-fifth.

Briefly mentioned, such are some of the main results of the Department's investigation of the meat supply. They indicate the proportions of the part that the farmer of this country takes, in only one direction of his work, as a provider of meat to now 85,000,000 fellow-countrymen and to the rest of mankind.

#### CONSUMERS' YEARLY MEAT BILL.

Meat consumers, as well as farmers who are meat producers, have concern with the national dietary. This nutritive element contributes one-third or more of the total assimilated nutrients of the dietary, both in pounds of protein, or flesh-forming material, and in calories of energy. In expense to the consumer the fraction is undoubtedly much larger. The investigations of the National Bureau of Labor into the retail prices of food indicate, for the many representative family budgets included in the investigations, that the average retail price of meat, for all kinds in the proportions of actual consumption, was 12 $\frac{3}{4}$  cents in 1900, 13 cents in 1901, and 13 $\frac{1}{2}$  cents in 1905; the average increased, perhaps, to 13 $\frac{3}{4}$ , or at the most to 14, cents in 1906.

At these average meat prices and with the meat consumption of 1900, the national retail meat bill was \$2,052,279,000 in 1900, and it was \$2,303,578,000 to \$2,345,461,000 in 1906. Every increase of one-fourth of a cent per pound in the national average retail price of meat raises the total yearly expense to consumers by \$41,883,000. The increase of one cent a pound since 1900 cost consumers this year \$167,533,000.

#### FUTURE PRODUCTION.

##### FAULTS OF THE PAST.

The mighty production of the farm for one-third of a century has come out of an agriculture having many faults. In a large degree there has been one-crop farming; crop rotation, as practiced, has often



been too short and unwise; the grasses and leguminous forage crops have been neglected, domestic animals have not sufficiently entered into the farm economy, and many dairy cows have been kept at a loss. The fertilizers made on the farm have been regarded as a nuisance in some regions; they have been wasted and misapplied by many farmers; humus has not been plowed into the ground as generally as it should have been; and in many a place the unprotected soil has been washed into the streams.

#### ECONOMIC JUSTIFICATION.

This, in few words, is the historic story of agriculture in a new country; yet the course of agriculture in this country, bad as it may seem in its unscientific aspect, has had large economic justification. While pioneers, poor and in debt, are establishing themselves they have no capital, even if they had the knowledge, with which to carry on agriculture to the satisfaction of the critic. They must have buildings, machinery, and live stock, even at the expense of the soil.

Millions upon millions of acres of fresh land have been coming into production faster than domestic consumption has required, and, at times, beyond the takings of importing countries. For many years the farmer was threatened with 40-cent wheat, 20-cent corn, and 5-cent cotton, and at times he was face to face with the hard conditions implied in these destructive prices. A more scientific agriculture would have raised wheat that no one wanted to eat, corn to store on the farm and perhaps eventually to be used for fuel, and cotton not worth the picking.

#### LARGER PRODUCTION INDICATED.

So it has happened, with reason, that the production per acre has been low; but there is no likelihood that low production is fixed and that the farmer must continue his extensive system. When consumption demands and when prices sustain, the farmer will respond. The doors of knowledge and example are opening wider to him.

There is abundant information concerning crop rotation, the dependence of high production upon the domestic animals, concerning grasses, clover, and alfalfa, and concerning the mixing of vegetable matter with the soil. Systems of farm management and soil treatment have assumed greater importance in their effect upon production; and there is the breeding of plants, which alone can multiply production so as to glut the market.

#### MULTIPLICATION OF THE COTTON CROP.

If there were need to do so, the cotton farmer and planter could double the present crop of two-fifths of a bale per acre, and the feat would need nothing more than demonstrated and well-understood principles of farm management. It would be no work of magic to multiply the production of cotton per acre by 3 and get a bale and a quarter; and, besides this, the planter has more than three times the present actual acreage in cotton readily available and awaiting his use. More than the present area of cotton can thus be grown in a three-year crop rotation when the needs of the world demand it.

## INCREASE OF CORN.

In accordance with principles demonstrated, known, and applicable, hints of which have been given, the corn crop per acre can be increased by one-half within a quarter of a century, and without any pretense that the limit has been reached. No wizard's services are needed for this, but just education.

## MORE WHEAT PER ACRE.

The same statement is applicable to wheat. There is no sensible reason why half as much again wheat may not be had from an acre within less than a generation of time. It is only a question of knowledge, of education, of cultural system, and of farm management, all of which learning is and will be at the service of the farmer as he needs it.

## GAIN IN OTHER CROPS.

Equally feasible is a 50 per cent increase in the crops per acre of oats, barley, rye, and buckwheat. Potatoes, instead of growing less than 100 bushels per acre, should double their production. Wherever only 600 to 800 pounds of tobacco are got from an acre, three-fourths of a ton is the prospect.

Fruits, berries, and vegetables have a future too large to estimate. The cannery and the railway fast freight and refrigerator car have overcome obstacles of latitude, of longitude, and of season, and there is every indication that the farmer can supply any possible demand for these foods at home or abroad.

## ANIMAL PRODUCTS.

Farmers will learn how to feed more prolific breeds and strains of swine than the ones which they are now chiefly raising, and thus will pork and its products be increased per individual of the permanent stock of hogs. One-fourth of the dairy cows of the country do not pay for their feed, and more than half of them do not return any profit; in proportion as the dairymen weighs the milk of each cow and applies the Babcock test will he increase the supply of milk, butter, and cheese. It is merely a matter of education.

Poultry is one of the steady and helpful sources of farm income. Movements are already on foot which may be expected to increase the egg production per hen by at least a dozen per year within a generation; and there are poultrymen who are not enthusiasts who foretell double that increase. If the hens of this year had each laid a dozen eggs more than they did, the increased value of this product would have been possibly \$50,000,000.

## A MATTER OF EDUCATION.

The farmer will not fail the nation if the nation does not fail the farmer. He will need education to know the powers of the soil which are now hidden from him. The prospective yearly expenditure of \$10,000,000 for educational and research work by Nation and States, with such increases as may come from time to time, must have enormous effects. There may be agricultural schools for the small children, and agricultural high schools for the larger ones, and their education will be continued in the colleges.

The work of the Department of Agriculture has already had results which are valued at hundreds of millions of dollars annually, and yet

the Department feels that it has barely crossed the threshold of its mission of discovery and education. Cooperating to the same ends are 60 experiment stations in 51 States and Territories, the 63 agricultural colleges, thousands of farmers' institute meetings yearly, many excellent agricultural periodical publications and new instructive books. Then there is a new line of work which is so productive of results that it is constantly extending, and that is the demonstration farm, the encouragement of individual farmers to change their agriculture so as to multiply their yields and their profits, and thus afford object lessons to other farmers.

Thus it appears that forces are now at work which will very considerably increase the production of the farms within a generation, and which promise to continue the increase indefinitely. He who would write the last chapter of the progress of the agriculture of this country must await the procession of the centuries.

#### OPENING OF A NEW ERA.

The farmer is financially in a position now to do what he could not have done previous to the recent years of his prosperity.

#### ADVANCE OF FARMERS' WELFARE.

National welfare has been promoted by few revolutions in agricultural economies to the extent that it has been and will be promoted by 10-cent cotton. The greater part of the cotton planters are out of their former bondage to future maintenance, and they are paying no enormous rates of interest for advancements—rates which were estimated fifteen years ago to average 40 per cent a year.

In the Middle West the prosperity of the farmers during the last half dozen years and over has advanced in such mass and with such speed that no parallel can be found in the economic history of agriculture. One of the great changes that have come over this region is the conversion of a million agricultural debtors, paying high rates of interest and finding great difficulty in procuring the wherewithal out of prices much too low, into financially independent farmers, debt-free, and begging the banks to receive their savings at as small a rate of interest as 2 per cent.

#### POWER OF THE FARMERS' NEW CAPITAL.

Farmers are using their new capital to abolish the waste places of the land. The river is leveed and alluvial bottoms subject to overflow become worth hundreds of dollars per acre for vegetables; a marsh is drained by ditches and tiles and celery makes it the most valuable land in the county; semiarid land is constantly cultivated so as to make a mulch of finely pulverized earth on the surface, and the crops that it will grow make the farmer prosperous; durum wheat or alfalfa is introduced and again the semiarid wastes are made to do the will of the cultivator; leguminous plants give humus and nitrogen to the sandy waste, to the use and profit of the farmer; the unused rocky, stony field or mountain side, offensive both to the economic and to the esthetic eye, blossoms with the apple, the peach, the pear, and the plum, and adds to the evidences that every square foot of the land may be made productive unless it is arid; and even then irrigation works, as far as water is available, swell the evidence. Along all of these lines of production farmers are using their newly acquired capital and are progressing as never before in their prosperity.



Formerly there was an abundance of farm labor and a dearth of farming capital; now these conditions are reversed and labor is scarce and capital abundant. Notwithstanding the farmers' inability to do some things for want of labor, the new situation is a great improvement upon the old one. The farmer can now employ every labor-saving device and thus reduce both the labor and the cost of production; he can raise his land to a higher state of fertility than can be made by chemical fertilizers alone, because he can advance the needed capital for permanent soil improvement and is in a position to await results; he can produce things that require years for the first crop, as in the case of fruits; he can provide such capital as is needed to distribute his products and thus cooperation is open to him to a greater extent than ever before; he can secure a better education for his children to the end, among other things, that they may do better with the old farm than he did.

#### PROMISING OUTLOOK.

The farmer's standard of living is rising higher and higher. The common things of his farm go to the city to become luxuries. He is becoming a traveler; and he has his telephone and his daily mail and newspaper. His life is healthful to body and sane to mind, and the noise and fever of the city have not become the craving of his nerves, nor his ideal of the everyday pleasures of life. A new dignity has come to agriculture, along with its economic strength; and the farmer has a new horizon far back of that of his prairie and his mountains, which is more promising than the sky-line of the city.

For the abundance that the Creator has sustained the farmer in supplying, for the stability of the national agriculture, and for the comforting prospect of a potent future, there are many evidences that the people are ready to join in a day of reverent and joyous Thanksgiving.

It is no little gratification to the head of this Department in presenting the foregoing picture of the farmer's place in the economy of the country and picturing the possibilities of his future to realize that this Department and its work have had an important share in the development which has culminated in the farmer's present prosperity, and that they are bound, if intelligently and generously administered, to play an important part in the future of American agriculture. With this thought in mind I will proceed to present for your consideration a review of the various channels through which the Department performs its important work and to place on record what has been done through them during the past year.

#### WEATHER BUREAU.

##### FORECASTS AND WARNINGS.

The Weather Bureau has issued warnings of dangerous gales on the Great Lakes and along the seacoasts, and has kept the great commercial and agricultural interests of the country as fully advised as possible of the coming of adverse weather conditions.

##### EXTENSION OF THE FIELD OF OBSERVATION.

Its field of observation is being gradually extended in the hope that a view of the atmospheric conditions which prevail over the great oceanic and continental areas will prove of especial value in making

forecasts for this country. The two points from which advices of atmospheric changes are most desired at present are Siberia and the region in and about Bering Sea. It is hoped to obtain reports from Siberia through the courtesy of the Russian Meteorological Service. The laying of a cable by the United States Signal Service, connecting Alaska with this country, makes it feasible to secure much-desired weather reports from that part of the globe.

#### EXTENSION OF STORM-WARNING SERVICE TO VESSELS AT SEA.

During the year a plan has been perfected whereby vessels at sea equipped with wireless telegraphic apparatus may receive warnings of severe storms if within communicating distance of shore stations, or of other vessels which have received a warning.

#### OBSERVATORY BUILDINGS.

Five observatory buildings have been completed during the year, and one (the physical laboratory at Mount Weather, Va.) has been partially completed. The number of buildings of all classes now owned and occupied by the Weather Bureau is 41.

#### DISTRIBUTION OF FORECASTS THROUGH TELEPHONE EXCHANGES.

The number of telephone subscribers receiving the daily forecasts on June 30, 1905, was 464,738. This number was augmented during the year by over half a million, so that at the close of this fiscal year more than a million telephone subscribers were receiving the daily forecasts.

#### INVESTIGATION OF FROST CONDITIONS IN CRANBERRY DISTRICTS.

A special investigation has been carried on during a part of the year, having as its object the establishment of a scientific basis for accurate frost predictions in the cranberry regions of the country, especially in Wisconsin. The conditions of both soil and air which shortly precede and accompany frost have been studied closely, and valuable data have been secured.

#### INCREASE IN THE WEATHER SERVICE.

The utilities of the Weather Bureau are such that there is a constant and growing demand for an extension of the service so as to provide for telegraphing and publishing more meteorological data and establishing additional Weather Bureau stations. However, special effort is made to meet these demands with the existing appropriation, and no request that involves asking Congress for additional funds is honored except after a careful and thorough investigation of the necessities of the case.

There is already an extensive output of meteorological information that comes from the 183 full meteorological stations maintained by the Bureau and from several hundred stations reporting only temperature and rainfall. The daily output finds its way to the public mainly through the columns of the newspapers and in the maps and bulletins

issued at Washington and outlying stations. Outside of Washington there are 105 stations which issue an aggregate of 25,000 weather maps daily, making a yearly issue of over 8,000,000 copies. The number of monthly climatological reports printed at 40 different section centers is 30,944, being an average of about 700 copies per month from each center; these contain the daily climatological features of various climatic districts. There is a constant demand from agricultural, commercial, and shipping interests for an additional amount of such data.

#### MOUNT WEATHER RESEARCH OBSERVATORY.

Progress has been made in the establishment of the Mount Weather Research Observatory. A station of the first order has been maintained throughout the year for taking and telegraphing reports that are useful in making forecasts.

In the preparation for kite and balloon work, a number of important instruments have been installed and made ready for systematic work. Observations of the upper air are now being regularly taken in concert with similar aerial research institutions in foreign countries.

The interior finishings of the magnetic observatory buildings, the erection of the piers, and the installation of the magnetic instruments were completed during the year, and automatic and other records are now being continuously made.

#### RECORDS OF EARTHQUAKES.

The attention drawn to scientific observation of earthquakes by the calamity that befell San Francisco on April 18, last, has prompted the Department to authorize the Weather Bureau to install an additional number of instruments at places of observation where the Department owns buildings and suitable ground. It is probable that during the coming year about 15 or 20 additional stations will be equipped with seismographs, so that the progress across our continent of earth vibrations can be more accurately measured and the data submitted for scientific discussion. These additional observations can be secured with only the expense involved in the purchase of instruments and their installation.

#### BUREAU OF ANIMAL INDUSTRY.

##### THE MEAT INSPECTION.

Meat inspection has been for several months a very live topic before the public. During the year the Federal meat inspection was conducted by the Bureau of Animal Industry at 163 establishments in 58 cities, and 42,901,284 animals were inspected at the time of slaughter, nearly all of them having also been previously inspected in stock yards. This represents the greatest amount of work done in any one year since the inspection was inaugurated in 1891. Of the animals inspected, 158,953 carcasses and 126,159 parts of carcasses were condemned for disease or other cause. The total cost of the meat inspection, including the microscopic inspection of pork for export to certain countries, was \$852,561.70.

The importance of more thorough meat inspection and sanitation has been forcibly shown by the recent agitation and investigations relating to some of the packing-house methods. The new law which was



designed to correct certain evils was passed by Congress June 30, 1906, and hence the work of the fiscal year under review was performed under former laws, which were, in many respects, defective and unsatisfactory. The act of March 3, 1891, as amended March 2, 1895, provided for the inspection of all live cattle intended for export or whose carcasses or products were intended for export; also for the mandatory ante-mortem inspection of cattle, sheep, and hogs, and the additional permissive post-mortem inspection of their carcasses for interstate trade. It has never been possible, however, to apply the inspection to all the establishments coming within the law, since the appropriations have been insufficient for that purpose. Many establishments which desired inspection have had to be refused because of lack of funds to extend the service. Many that should have been compelled to have inspection were able to avoid it, as the former laws compelled inspection only in the case of export beef.

The law gave the Department no authority whatever to control the sanitation of abattoirs and packing houses, or to prevent adulteration or the use of chemicals and preservatives; nor was any authority given for following up meats which had once been inspected and passed immediately after slaughter, or for condemning any such meat which might afterwards have become unwholesome or unclean before or during the process of canning or packing or before being placed on the market. The inspection was therefore practically limited to the ante-mortem inspection of animals and the inspection of the carcasses immediately after slaughter. The meat found free from disease and otherwise wholesome at the time of this post-mortem inspection was properly marked, and that found diseased or unwholesome was destroyed. This inspection was efficient so far as it went, and it went as far as the law and the limited appropriations permitted. In its efforts to maintain an efficient inspection the Department sometimes even assumed authority not conferred by law, notably by requiring the destruction of condemned carcasses. In all the recent agitation the wholesomeness of the inspected fresh meat has not been seriously questioned. The disclosures of unsatisfactory conditions have related almost wholly to matters over which the Department had no legal control, such as the preparation of sausages, canned and cured meats, etc., the use of preservatives, and the insanitary condition and methods of the packing houses.

Realizing the shortcomings of the old law, the Department has several times in the past recommended the enactment of new legislation and the increase of appropriations for the extension and improvement of the service. Bills designed to remedy some of the defects were at different times introduced in Congress but failed to pass.

Even before the appearance of recent publications criticizing the insanitary conditions at the Chicago stock yards and packing houses, and reflecting upon the Federal meat-inspection service, steps had been taken to investigate these matters. A committee consisting of Dr. John R. Mohler, chief of the Pathological Division of the Bureau of Animal Industry, Dr. Rice P. Steddom, chief of the Inspection Division of that Bureau, and Mr. George P. McCabe, Solicitor of the Department, was sent to Chicago and made a thorough investigation. They made an exhaustive report, which was promptly transmitted to the President and was afterwards by him laid before Congress. An independent investigation was also made under the President's direc-

tion by Messrs. Charles P. Neill and James B. Reynolds. Prompt and vigorous measures were taken to remedy the conditions disclosed by the reports of these committees, but it was realized that the Department could do very little under existing law and that the real remedy lay in new legislation backed by public sentiment.

Such new legislation was provided by Congress in the so-called meat-inspection amendment to the agricultural appropriation act of June 30, 1906. This law provides for a more thorough and comprehensive inspection system and makes a permanent annual appropriation of \$3,000,000 to pay the cost of the inspection. With the greater authority now vested in the Secretary of Agriculture and with the largely increased appropriation, the service will be greatly extended in scope and in the number of establishments and quantity of product covered. The inspection will be extended as rapidly as possible to establishments engaged in interstate or foreign commerce and which come within the law. It will be applied not only to the live animals before slaughter and their carcasses at the time of slaughter, as heretofore, but also to the meats and meat food products in all the subsequent stages and processes of preparation, curing, canning, etc. Sanitary equipment, conditions, and methods will be required, the use of harmful chemicals and preservatives and of false and misleading labels will be prevented, and the transportation of meat in interstate and foreign commerce will be supervised and regulated. It is probable that it will be necessary to request Congress to appropriate an even larger sum to provide inspection for all establishments embraced within the law.

American live stock has long been considered the healthiest in the world. With our enlarged and improved inspection system, the stamp of the Government will be more than ever a mark of wholesomeness.

We must not imagine, however, that since the packing houses have been cleaned up and the inspection improved all the meat found in our local markets may be considered clean and wholesome. It must be borne in mind that the Federal jurisdiction is limited to interstate and foreign commerce, and that this inspection can legally be applied only to establishments doing an interstate or foreign business. To be sure, the Department insists on inspecting the entire output of each establishment at which its inspection is maintained, even though part of the product is to be consumed within the State; but the Federal inspection does not and can not reach the establishments doing business exclusively within a State. The Department, under the new law, can and will enforce cleanliness and sanitation in the establishments doing an interstate and export business, but it is powerless to reach the local houses. The latter must be looked after by the State and municipal authorities. Each State or community must protect itself against unwholesome meats originating within the State. In the absence of an efficient local inspection the consumer's only safety lies in seeing that meat bears the Government label.

#### INSPECTION OF EXPORT ANIMALS.

The export trade in live animals is fostered by the inspection conducted by the Bureau of Animal Industry. During the fiscal year more than 1,000,000 inspections were made before exportation, and over half a million animals were again inspected on arrival at British ports by Bureau inspectors stationed there. Seven hundred and forty-nine inspections of vessels carrying export animals were made before



clearance, and they were required to conform to certain regulations as to space, fittings, attendants, feed, water, ventilation, etc. The percentage of animals lost in transit was less than one-quarter of 1 per cent.

#### INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

Our domestic live stock is protected from the contagion of destructive diseases which exist in other parts of the world by a rigid system of inspection and quarantine of imported animals. In this service during the year 168,600 animals were inspected, and 1,898 of these were quarantined.

The quarantine stations on the Atlantic seaboard, with one exception, are in satisfactory condition. The station near Baltimore will soon have to be abandoned because of the dilapidated condition of the buildings and the building up of that locality. When a suitable location is secured an appropriation by Congress for the equipment of the new station will be necessary.

#### CONTROL OF CONTAGIOUS DISEASES.

The work for the control and eradication of contagious diseases of live stock in our own country has been attended with encouraging results. Sheep scab and cattle mange, which a few years ago had spread over the greater part of the Western States, are gradually yielding to our efforts. It is believed that their complete eradication will be only a matter of a few years. During the year sheep scab has been greatly diminished in Arizona and Idaho, and practically stamped out in Utah and Wyoming. Even more rapid progress has been made with cattle mange. Washington and Oregon, and large portions of Kansas, Colorado, Wyoming, Texas, New Mexico, and Oklahoma, have been freed from this disease and released from quarantine, and it is expected that the same will soon be true of extensive areas in North Dakota and South Dakota and other portions of Wyoming and Texas.

Maladie du coït, or dourine, an insidious venereal disease of horses, which existed in portions of South Dakota, Nebraska, and Iowa, is now believed to have been eradicated, after several years of vigilant work. Out of 965 inspections during the year no positive cases and but 3 suspicious cases were found.

#### ERADICATION OF THE TEXAS-FEVER TICK.

Under the provisions of the act of Congress approved June 30, 1906, appropriating \$82,500 to enable the Secretary of Agriculture to undertake experimental work in cooperation with State authorities in eradicating the ticks transmitting Southern cattle fever, the Department has for some months past been assisting the States and Territories from California to Virginia along these lines. Anticipating the action of Congress an investigation was made respecting the laws of the various States, and through the various attorneys-general inquiry was made relative to the existence of State laws under which the Government could undertake the work of tick eradication. It was found that, while some State laws afford ample provisions, other States either have no law bearing on the subject, or the statutes are inadequate. The table following shows the particular points covered by the investigation and the general trend of the information received.

*Provisions of State laws relating to quarantine, disinfection, etc.*

State.	Questions and answers.			
	Are local officers authorized and empowered to enter premises to inspect live stock and enforce quarantine, including counties, districts, farms, and ranches, and to control the movement of live stock?	Are such officers empowered to enforce such disinfection of animals and premises as may be necessary?	Are State officials authorized to issue rules and regulations establishing and maintaining quarantine lines?	May the State confer authority upon Federal representatives to act as officials of the State in such matters?
Alabama .....	No live-stock quarantine or sanitary law.			
Arkansas .....	Peace officers may enforce quarantine lines fixed by law and by the United States.	No .....	No .....	
California .....	Yes .....	Impliedly .....	Yes .....	As county officials only.
Florida .....	No live-stock quarantine or sanitary law.			
Georgia .....	Yes; impliedly so. ....	Yes .....	Yes .....	Not prevented.
Indian Territory ..	No law to cover these matters.			
Kentucky .....	Yes .....	Yes .....	Yes .....	Yes.
Louisiana .....	Yes; impliedly so. ....	Yes .....	Yes .....	No.
Mississippi .....	No live-stock quarantine or sanitary law.			
Missouri .....	No .....	No .....	No .....	No.
North Carolina .....	Yes .....	No .....	Yes .....	Yes.
Oklahoma .....	Yes .....	Yes .....	Yes .....	Yes.
South Carolina .....	No law to cover these matters.			
Tennessee .....	Yes .....	Yes .....	Yes .....	Not prevented.
Texas .....	Yes .....	Yes .....	Yes .....	No.
Virginia .....	Yes .....	Yes .....	Yes .....	Yes.

The matter was early taken up with the proper officials in the States and Territories interested and arrangements were made for the Department to cooperate with them to the extent that their respective laws would permit. Under these arrangements the work has been done in close cooperation with the local authorities, who were permitted to designate the counties or localities to be covered and to recommend for appointment as agents of the Department men acquainted with the local conditions in the respective localities.

The territory in which it was desired to operate was divided into five sections, as follows:

1. California.
2. Texas, Oklahoma, Missouri, Arkansas, and Louisiana.
3. Kentucky, Tennessee, Alabama, and Mississippi.
4. Georgia and South Carolina.
5. Virginia and North Carolina.

The work was organized as soon as possible after the passage of the law, but it was late in July before it could be begun at all, and even later before it could be taken up in some sections.

As the conditions in the different sections were widely divergent, the plans of procedure and methods employed necessarily varied greatly. In some States meetings were held at which the subject of tick eradication was discussed with farmers, stockmen, and other interested citizens. These meetings were intended to be largely educational, but they gave an opportunity to petition State authorities for relief and to express preference for local inspectors, thus developing an enthusiasm and interest that can only come from a close personal identification with an enterprise of this sort. In some places it was necessary to employ inspectors who could live in the saddle and wield a lasso like a cowboy. These men worked in groups of about a dozen, each group having a cook and a camping outfit. They covered their territory systematically, roping and examining cattle wherever found,

and informing the owners of infested animals of the most practical method of getting rid of the ticks. It was found advisable to buy a carload of crude petroleum (in barrels) for use in the treatment of infested animals. This oil was distributed and used under the immediate supervision of inspectors of the Department in the southeastern States, and was doubtless the means of doing what could have been done in no other way, as the crude oil is difficult to obtain in small quantities and at points far distant from its production.

The table following shows by States the number of herds inspected, the number of cattle inspected, the number found free of ticks, and the number found to be infested—the grand total of inspections being 29,315 herds containing 522,529 cattle.

*Results of inspection work to October 31, 1906.*

State.	Inspections.				Number of counties.
	Herds.	Cattle.			
		Free.	Infected.	Total.	
Alabama .....	780	4	5,550	5,554	2
Arkansas .....	1,527	6,671	2,332	9,003	2
California .....	1,015	67,517	58,889	126,406	11
Georgia .....	4,474	10,053	6,365	16,418	7
Kentucky <sup>a</sup> .....	4,077	13,653	7,332	20,985	4
Missouri .....	126	3,000	1,430	4,430	3
North Carolina .....					
Oklahoma .....	10,589	97,860	16,972	114,832	5
Tennessee <sup>b</sup> .....	6,317	23,204	15,840	39,044	17
Texas .....	410	86,682	99,175	185,857	17
Virginia .....					
Total .....	29,315	308,644	213,885	522,529	68

<sup>a</sup> In addition, in Kentucky 1,396 herds and 6,904 cattle were reinspected.

<sup>b</sup> In addition, in Tennessee 822 herds and 4,174 cattle were reinspected.

The work is still progressing in some States, but will be practically discontinued about December 1 on account of the lack of funds. The outlook for next season's operations in the different infested sections is very encouraging, and the work should be resumed in the early spring.

In considering the work done and the results attained thus far it should be borne in mind that the season was well advanced before the law was passed, and that, although some steps were taken in anticipation of its passage, yet the actual plans and organization for the work were late in formation. It should also be remembered that the amount appropriated was only intended to be used to inaugurate the work, and yet, as set forth above, employees of the Department have inspected 29,315 herds, containing 522,529 cattle, and have, in connection with local authorities, so attended to their disinfection and to the supervision thereof that forty whole counties and parts of eleven other counties, with an aggregate area of almost 50,000 square miles, will probably be released from quarantine before the end of this fiscal year. This is an area larger than that of the entire State of Virginia. Plans are laid and specific work is outlined for resumption in the early spring. The State officers, cattle owners, and others affected are intensely interested; educational work will be carried on, and there is every reason to believe that, with proper funds at the disposal of the Department next season, large inroads may be made into the territory now quarantined, and hundreds of thousands of cattle be given an unrestricted market, thus giving direct results to an immense number



of people. This will stimulate interest in those States in which active interest is now lacking and will doubtless result in a more general movement against the cattle tick.

If the Congress at its next session will appropriate \$250,000 for extending these operations and will continue to adequately sustain them, and the States interested will do their part in the way of enacting favorable laws and appropriating money to be used in this cooperative work, it is only a question of time when the southern cattle tick in this country will be a thing of the past.

#### SCIENTIFIC INVESTIGATION OF DISEASES.

The scientific investigations of contagious diseases by the Bureau of Animal Industry have yielded results of especial importance with regard to tuberculosis and hog cholera during the past year.

##### TUBERCULOSIS.

The increasing and alarming frequency of tuberculosis in hogs, as observed in the meat-inspection service during recent years, led to experiments to determine the most probable source of infection of these animals. The practical conclusions of these investigations are that the most frequent causes of tuberculosis in hogs are to be found in the common practices of allowing these animals to follow cattle in the feed lot and of feeding them on skimmed milk or separator refuse. The feces of tuberculous cattle have been found to be heavily charged with tubercle bacilli. The experiments indicate that animals with tuberculous lungs, while they do not expectorate after coughing up tuberculous material, nevertheless scatter the bacilli freely by swallowing them, having them pass through their intestines, and discharging them with their feces. Hogs readily contract tuberculosis from eating the excrement of tuberculous cattle. For milk to be infected with tubercle bacilli it is not necessary that the udder should be diseased; infected feces are believed to be a common cause of contamination of milk drawn in the environment of tuberculous cows. Thus it seems that a single diseased cow may be the means of infecting the milk of an entire herd.

Other experiments showed that the location of lesions in the bodies of animals affected with tuberculosis is no guide to the mode or channel of infection. For instance, lesions in the lungs have usually heretofore been regarded as indicating that the infection was acquired by inhalation. The incorrectness of this view was shown by producing lung disease by inoculating hogs in the tip of the tail and by feeding them with tuberculous material.

These results emphasize anew the great importance of every farmer keeping his herd free from tuberculosis.

Experiments in the application of the tuberculin test to hogs showed that when proper precautions are taken tuberculin is about as accurate in detecting tuberculosis in hogs as in the case of cattle. The test was found reliable in 97 per cent of the infected experimental animals.

##### HOG CHOLERA.

Hog cholera has long been a cause of heavy loss to the farmers, and for years scientists in the Department and in various parts of the world have been working on the problem of the cause and prevention

of this disease. Recent work of the Bureau of Animal Industry has demonstrated that the contagion consists of a virus which exists in the blood and other fluids of diseased animals, but which can pass through the finest filter, is invisible under the microscope, and therefore can not be isolated or discerned by any of the usual methods. This important discovery, which has since been confirmed by eminent scientific authorities in England and on the Continent of Europe, affords an explanation of the failure of past efforts to produce a satisfactory vaccine.

The real cause of the disease having at last been determined, the Bureau has during the past season conducted experiments with a view to producing a vaccine or serum which will prevent or cure the disease. Successful results have already been obtained in an experimental way, and efforts are now being made to adapt the method to practical and general use. The method has been patented by the Department in the name of the scientist who evolved it, Dr. Marion Dorset, the patent having been taken out in such a manner as to insure to all the people in the United States the right to its use free of royalty.

#### PARASITES OF SHEEP.

The stomach worm or twisted wireworm of sheep, a parasite causing great damage to flocks in many parts of the United States, has been studied, and the principal facts in its life history, which have hitherto been unknown, have been worked out. The eggs of the parasite are scattered over the pastures in the droppings of infested sheep or cattle. The embryos, which in a certain stage are enveloped in a sheath which enables them to withstand freezing and dryness, climb up blades of grass. When infested grass is eaten by a sheep the embryos continue their development in that animal. Experiments now in progress indicate that with certain precautions it is entirely feasible to raise lambs free from this and some other troublesome parasites.

#### BLACKLEG VACCINE.

The Department has continued to supply blackleg vaccine free of charge to stock owners, and reports indicate that the prevalence of this disease is gradually being reduced. During the year 1,350,915 doses of this vaccine were prepared and distributed. The losses among animals treated with this vaccine during the previous year were less than one-half of 1 per cent.

#### PEDIGREE ASSOCIATIONS.

After consultation with officers of American pedigree record associations, the Department has radically changed the regulations regarding the importation of animals for breeding purposes. Hitherto certificates of approved domestic and foreign associations have been accepted with the requirement that they should show the ancestors for two generations. This requirement caused inconvenience and dissatisfaction to importers, but the Department felt that unless it could supervise more closely the books of record such a requirement was necessary to give a reasonable assurance of pure breeding. The new regulations simply require that animals imported for breeding purposes shall be registered in an approved American book of record in order to be entitled to free entry. Where a breed has no book of record in the United States the certificate of the Chief of the Bureau

of Animal Industry must be obtained. The records of the approved associations are closely supervised by the Department and must conform to prescribed conditions in order to remain on the approved list. This change should prove beneficial to the breeding industry. It will not only make officers more careful in the management of pedigree registers, but will practically compel the registration of imported pure-bred animals in American books.

#### HORSE-BREEDING INVESTIGATIONS.

Satisfactory progress is being made in the experiments in breeding heavy harness horses at the Colorado Experiment Station. The stud has been increased by the purchase of two Kentucky mares of desirable strains of breeding. It is considered advisable to increase further the number of experimental animals, and the Department should be prepared to purchase exceptionally good mares as opportunity offers. This line of experiments promises to be of the greatest value to American stockmen and should be carried out systematically and thoroughly.

Experiments have been begun, in cooperation with the Vermont Experiment Station, in breeding Morgan horses with the object of preventing the loss of the Morgan blood, preserving the type, and increasing the size. Seven mares and two fillies were purchased in Vermont and two mares in Kentucky for these experiments.

#### FECUNDITY OF SOWS.

Some unexpected but instructive results were obtained by a study of the fecundity of Poland-China sows. It had been supposed that this breed of hogs was declining in fecundity, and the Department was urged to undertake experiments with a view to overcoming this tendency. An investigation into the pedigree records and a comparison of two periods of years, based upon nearly 55,000 litters, showed that the average number of pigs per litter was 7.04 during the years 1882-1886, and 7.52 during 1898-1902. There was thus an increase of 0.48 per litter instead of a decrease. These results led to a similar investigation of the Duroc-Jersey breed, and while the popular supposition that this breed is more prolific than the Poland-China was confirmed, it appeared that the average size of litters of Duroc-Jerseys had remained practically stationary for several years, the figures being 9.22 for 1893-1897 and 9.27 for 1898-1902. These investigations are being followed with studies of the inheritance of fecundity.

#### POULTRY BREEDING.

Investigations, with a view to developing a strain of chickens with increased egg-laying capacity, are being conducted in cooperation with the Maine Experiment Station. Several hens have been found to lay more than 200 eggs in one year, and the results seem to indicate that by selecting the best layers for breeding purposes and by proper feeding the average egg yield of a flock can be increased. The great benefit of such an increase is too obvious to require comment.

#### EXPERIMENTS IN ANIMAL NUTRITION.

A careful scientific study of the fundamental principles of animal nutrition by means of a respiration calorimeter has been in progress for several years at the Pennsylvania Experiment Station by cooperation between the Department and that station, and some important



and valuable results have been realized. Beginning with the food as a source of energy to the animal machine, the investigators follow this energy through to its ultimate effect, determining how much escapes in the undigested residues of the food, how much is expended in the digestion and assimilation of the food, and what surplus remains to sustain the life of the animal or to enable it to produce meat, milk, or work.

The results thus far published include experiments with timothy hay, red clover hay, and corn meal, and they have shown that the so-called "fuel value" of feeding stuffs can not be taken as a measure of their nutritive value. The experiments have amply demonstrated that the real nutritive values of stock feeds are much less than their fuel values, the former ranging from 56 to 67 per cent of the latter in the particular feeds used. Experiments to study the effect of age and breed upon the percentage of food energy utilized have not been concluded.

#### FEEDING COTTON-SEED PRODUCTS TO HOGS.

The Bureau of Animal Industry has conducted experiments during the year to test the harmful properties of cotton seed and cotton-seed meal when fed to hogs. These substances proved fatal to the hogs, the time required to cause death being longer when a varied ration was fed than when only one kind of grain was fed in addition to the cotton-seed meal. The results obtained by experiment stations as to the fatal effects of cotton-seed products in combination with corn meal were confirmed, but it appears from the Department's experiments that bran and middlings, instead of neutralizing the injurious effect of the cotton seed, as had been concluded from experiment station work, gave results very little better than corn meal. The experiments with bran and middlings will be repeated and other tests made. Chemical and pathological studies are being made with a view to discovering the cause of the harmful effects of cotton seed when fed to hogs.

#### THE DAIRY INDUSTRY.

The work of the Dairy Division of the Bureau of Animal Industry has been considerably extended during the year. Results of a valuable and practical nature to the dairy industry have been obtained from investigations in the manufacture and storage of butter and cheese and the production and delivery of market milk; and a good beginning has been made in the work for the improvement and development of dairying in the South and the investigations and studies regarding the construction of dairy buildings and the organization and management of dairy enterprises.

#### BUTTER INVESTIGATIONS.

About 5,000 pounds of butter were made under different conditions and stored for eight months at different temperatures. The conclusion from this experiment is that the use of cream received at the creamery in a sweet condition, light salting of the butter, and low temperatures ( $10^{\circ}$  F. below zero to  $10^{\circ}$  F. above zero) give much the best results for storage butter.

Two common troubles of butter makers—mold in butter tubs and the fishy flavor of butter—have been studied. The coating of tubs with paraffin has been found to be an effective method of preventing mold. Investigations regarding the fishy flavor have not progressed far enough to determine the cause of this trouble, and are being continued.

A system of market inspection of butter at New York and Chicago has been started with a view to assisting creameries to improve the quality of their product. When butter arriving at one of these markets is found deficient in quality a statement of its condition is sent to the butter maker, to the dealer who purchases the butter, and to the dairy and food commissioner of the State in which the butter was produced.

#### CHEESE INVESTIGATIONS.

Further work was done during the year in the manufacture and storage of cheese. A quantity of American Cheddar style cheese was made, cured, and stored under varying conditions, and the details of the experiments, with a review of previous work on the subject, were published. The cheese that scored highest was that placed in storage at 32° F. directly from the press, while that scoring lowest was cured entirely in the factory curing room at about 65° F. Cold curing appears to derive its value chiefly from its effect on what otherwise might be poor cheese. The popular taste is growing decidedly toward mild cheese, and to meet this demand it seems desirable to have cheese ripened, so far as it is ripened at all, at low temperatures.

The experiments in the manufacture of soft cheese of leading European varieties have been continued throughout the year in cooperation with the Storrs (Conn.) Experiment Station. During the winter a scientist connected with this work spent two months in Europe studying the manufacture of cheese, and these studies have resulted in marked progress in our investigations regarding Camembert and Roquefort cheese. While there are some problems yet to be investigated, the knowledge so far gained of the fungi, methods, and conditions necessary in the production of these kinds of cheese indicates that it is entirely practicable to manufacture in this country soft cheeses of these types fully equal to the best European product.

#### THE PRODUCTION AND HANDLING OF MILK.

Probably no article of food is more generally consumed than milk, and in striving for pure foods a wholesome milk supply must be considered of prime importance. During the year the Dairy Division has investigated the milk supplies of various cities, and has begun studies of the organization and working of milk sanitary commissions and other bodies whose object is to improve the quality of market milk.

The competitive exhibit of milk and cream at the National Dairy Show in Chicago in February was in charge of the Dairy Division and gave an object lesson of great educational value. It was demonstrated that milk and cream produced under sanitary conditions could be shipped long distances and kept sweet for several weeks without any other means of preservation than cleanliness and low temperatures.

#### DAIRY IMPROVEMENT IN THE SOUTH.

A careful survey of dairy conditions in the South has been made at the first step in the work of improving these conditions and promoting the dairy interests of that section. This preliminary work has shown that while in some cases southern dairy herds are yielding as good results as are ordinarily expected in any part of the country, there is great need throughout the South for education in improved methods of dairy breeding and feeding and milk production. Many of the south-



ern people show a desire to learn more of dairying so as to get away from the one-crop system. One serious handicap is the inferior class of cattle found there, probably due largely to the presence of the cattle tick.

#### OTHER DAIRY WORK.

To meet the demand for information and assistance as to the construction of dairy buildings, some studies and experiments have been and are being made. A circular giving plans for an improved dairy barn was published, and many plans for dairy buildings of various kinds have been worked out and sent to farmers throughout the country. Some experiments have been made in building silos of three types of construction.

Investigations into the organization, equipment, and management of creameries and cheese factories have been undertaken to enable the Department to give advice and assistance on these subjects.

#### RENOVATED BUTTER.

In the administration of the portion of the law of May 9, 1902, which relates to renovated butter, the Department has continued its supervision of the manufacture and sale of this article. The factories and ingredients are inspected to insure sanitary conditions and wholesomeness, and the product is inspected in the markets with a view to detecting and preventing violations of the law and regulations as to proper labeling. The factories are in better sanitary condition than in past years, and as a rule the manufacturers show a disposition to comply with the law and regulations. Evidence of the illegal sale of renovated butter by dealers in several cities has been collected, however, and some prosecutions have been instituted. The regulations of the Department have been sustained in two court decisions.

#### BUREAU OF PLANT INDUSTRY.

A leading feature of the work of the Bureau of Plant Industry during the past year has been the cooperative demonstration work with farmers, fruit growers, and others. It has been my established policy to have our own officers carefully scrutinize all operations, including those which involve the conducting of business as well as those in which both field and scientific investigations are concerned.

#### INTRODUCING NEW CROPS AND NEW INDUSTRIES.

The search by agricultural explorers in foreign lands for new crops has been continued. A trained man has spent the last year in the cultivated fields and wild mountains of north China and Manchuria searching for new plants and seeds worthy to be transplanted to this country and for wild forms of our cultivated fruits and vegetables which may have characters of hardiness or unusual vigor that will make them useful for the plant breeders of the United States. Shipments of scions and of seeds representing hundreds of interesting things have been sent in and are now growing in the trial gardens of the Department. Among the things secured are new hardy Pekin persimmon varieties, interesting varieties of the English walnut, the Chinese pistache, wild and cultivated apricots, the wild peach from its supposed original home, hardy apples and edible-fruited hawthorns, millets and field beans, a lawn sedge that is promising, and a very

remarkable lot of Chinese grape varieties, not to mention a most unusually interesting collection of ornamental trees and shrubs suited to the climate of the Eastern and Middle States.

**NEW ALFALFAS AND OTHER CROPS.**—One of the most important achievements of the Bureau's exploration work is the recent discovery by Prof. N. E. Hansen, of the South Dakota Agricultural Experiment Station, who is now abroad in the interest of the Department, of the existence of a Siberian alfalfa, an excellent forage plant with yellow instead of the usual blue flowers. This plant is native on the dry steppes of Siberia, where the mercury sometimes freezes without snow, thus proving the ability of the plant to withstand with no protection a temperature of about 40 degrees below zero. The existence of this alfalfa has been suspected for many years, and its final discovery, it is believed, may mark an epoch in the agriculture of the northwestern prairie regions of the United States, where the rainfall is slight and the winters are exceedingly cold. Professor Hansen is making a very careful study of this plant, with a view to its cultivation in this country. A quantity of the seed of this valuable crop has been secured, which will be given a thorough trial by the Department at an early date. It will supplement durum wheat in a rotative system and avoid the necessity of summer fallowing.

The most distinct of any of the alfalfas is the newly introduced Arabian, characterized by its large leaflets, hairiness, and vigorous growth. Its quick recovery after cutting renders an extra cutting possible in long seasons. It is proving of special value in the irrigated sections of California and the Southwest, though its lack of hardiness makes it unsuited to the colder parts of the country. Attempts are under way to establish strains resistant to cold and drought.

A species of vetch called the Tangier pea has proved superior to all others in California in its luxuriance of growth, having yielded as high as 9 tons of green feed per acre. On account of this great amount of herbage it chokes out weeds very effectually. As a green manure crop it promises in California to supersede all others. Its value as forage remains to be ascertained. A large quantity of seed is being grown so as to introduce it extensively next season.

A most luxuriant subtropical grass, called the Para grass, has proved well adapted to the Gulf coast region, Arizona, and California. Where sufficient moisture is provided this grass will yield about 8 tons of hay per acre. It is coarse in quality, but very nutritious. The seed is very poor in quality, but the grass can readily be grown from cuttings, one plant covering 100 square feet or more in a season. It is planned to distribute the cuttings extensively in the spring of 1907.

**ENCOURAGING THE MATTING INDUSTRY.**—The United States imports every year larger and larger quantities of hand-made floor coverings made from several species of aquatic rushes and sedges that grow pretty generally over the world. In 1906 more than 50,000,000 yards were imported, and more than \$4,000,000 paid for them, notwithstanding the fact that looms have been invented that can weave the rushes into useful floor mats. These looms, the result of American ingenuity, when tended by single operators, can turn out more than 30 yards of matting a day—a strong contrast to the hand looms in use in foreign countries from which we draw our supplies of matting. The common rushes of our neglected swamp lands and tidal regions can be made into matting, but these lack the delicate, slender character of the cultivated forms in use in the Orient, India, and Africa.

Our explorers have been gathering living plants of the best foreign varieties, as well as selecting the most promising native types for trial plantings in the abandoned rice plantations of the Carolinas and for the delta regions of the Mississippi and Rio Grande, where cheap lands, which are not now growing profitable crops, are waiting for a new plant culture.

**A NEW SUBTROPICAL FRUIT.**—The Florida fruit growers have had their enthusiasm aroused this year by the ripening of several of the delicious, fiberless East Indian mangoes which the Department has introduced. The collection is one of the largest in the world, and Florida growers are waiting to see the behavior of the different sorts now under trial before planting large areas in this fruit, without doubt one of the great fruits of the world.

**SUCCESSFUL DATE CULTURE.**—The date palms introduced by the Department into southern California and Arizona have borne hundreds of pounds of delicious fruit this year. Even the famous Deglet Noor from the Sahara has ripened perfectly in the Salton Basin, proving that this unique desert culture has passed from the stage of a pure experiment into that of a new industry.

**THE PISTACHE NUT.**—The investigation of the pistache, a promising dry-land nut crop, has resulted in a distinct widening of the possibilities of its culture through the introduction from Turkestan of hardy forms. Three wild species suitable for stocks have been introduced from the driest deserts of the Old World, and a very hardy stock has also been secured in northern China.

#### INVESTIGATIONS BY THE PATHOLOGISTS.

The year has been an unusual one in the field of plant pathology. There have been serious outbreaks of disease and the staff of men engaged in this work has been kept very busy.

**PEAR BLIGHT.**—The Department has worked out by careful bacteriological investigation methods of controlling this serious menace to the pear and apple industry. The disastrous attacks of the old eastern pear blight upon the magnificent pear orchards of California have brought into prominence the importance of this work. During the past six years the Department has been engaged in demonstrating on a small scale in certain isolated orchards the practicability of controlling the disease, mainly by the eradication of the blighted portions of the tree and the antiseptic treatment of the wounds. Strenuous efforts are being made by the Department, in cooperation with the State experiment station and the State and county horticultural commissioners of California, to assist in applying these methods in saving the California orchards. The pear orchards of California represent a valuation of about \$15,000,000, producing an average annual income to the fruit growers of \$1,500,000. One-third of this, at least, has already been destroyed, but we hope to help the growers to save the remainder. Pear blight is destroying the pear industry in several other western States, and urgent requests have been made for assistance, which the Department expects to grant as far as it is able.

**LITTLE PEACH AND PEACH YELLOWS.**—The little peach disease has now been kept under control for three years on the test area in Michigan, and it is believed that the efficacy of the method has been fully demonstrated there. Work has therefore been transferred to a similar demonstration, in cooperation with the Cornell Experiment



Station, in a test area in Niagara County, N. Y. This is confidently expected to show the possibility of greatly reducing the ravages of the little peach disease and also of the peach yellows.

Peach yellows has been unusually destructive in West Virginia and Maryland during the past season. Department experts have been studying the disease in cooperation with the West Virginia State Experiment Station and urging the application of eradication methods. In one district, at least, in West Virginia, fully 90 per cent of the peach trees have been destroyed by the yellows during the past three years, and mainly during the present season.

APPLE BITTER ROT IN THE OZARK MOUNTAIN REGION.—Last season's successful spraying experiments in Virginia demonstrated for the first time the possibility of controlling bitter rot of the apple on the Yellow Newtown variety and indicated the exact dates of treatment. This work has now been transferred to the Ozark districts of Missouri and Arkansas. Here it has been tested on a much larger scale and on different varieties of apples. The results fully corroborate last year's conclusions and have demonstrated the entire feasibility of practically complete control of this serious orchard disease. Some minor rots and defects of the apple have also been more completely brought under control as a result of this treatment.

GUMMING FUNGUS OR SHOT-HOLE FUNGUS OF THE PEACH.—The gumming fungus or shot-hole fungus has been increasing in California at an alarming rate during the last five or six years and has resulted in very severe losses to the peach growers of that State. It threatens the destruction of the peach industry of the Sacramento and San Joaquin valleys. A treatment was suggested, after proper study by Department officials, which has been wholly successful.

WILT-RESISTANT MELONS.—Wilt has nearly destroyed the watermelon industry in many sections of the South. All known varieties of melons have been tested, but none resistant to the disease was found. It was found, however, that the citron is resistant, and the Department undertook by hybridization to breed this quality into the melon. The result has been successful, and there has been secured and fixed a variety of melon very resistant to wilt—a heavy yielder, of excellent quality, and well adapted to shipping. Next season it will be propagated for distribution.

WILT-RESISTANT COTTON.—The wilt-resistant selections of Sea Island cottons are now regularly used in the infected soils in the Sea Island districts of South Carolina. The loss from wilt has thus been practically eliminated in the principal region in which this special cotton is grown. The disease is still causing much loss in the interior districts, where this variety of cotton is grown, owing to the fact that many of the growers do not appreciate the value of resistant seed. Demonstration tests, however, are rapidly convincing them. Excellent wilt-resistant selections of Upland varieties have also been secured. Seed will be distributed this year to cooperators and propagated next year for more general distribution.

DISEASE-RESISTANT POTATOES.—For several years this Department has been testing various American and European varieties of potatoes, especially for disease resistance, and has now secured several good varieties resistant to both the early and late blight, as well as to tipburn and flea beetles. The work is carried on principally in cooperation with the Vermont Experiment Station, though several other States are also cooperating.

## PROGRESS IN CEREAL WORK.

**EXTENSION OF THE WINTER WHEAT AREA.**—About four years ago the Department began a systematic distribution of the Kharkof wheat, and extensive trials of this variety in cooperation with the State experiment stations. It is the hardiest winter wheat yet grown in this country, and is now thoroughly established. By its use the area in which winter wheat can be successfully cultivated has been much extended to the northward and westward, particularly in Nebraska and Iowa, while a considerable amount is now grown in South Dakota and southern Minnesota. It will be conservative to state that wherever this wheat has been introduced the yield per acre is being increased on an average of 5 bushels.

**ESTABLISHMENT OF WINTER BARLEY.**—Much attention has been given this year to the introduction and development of winter varieties of barley. It is well known that fall-sown grain will yield much more on the same ground than spring-sown grain, in addition to the fact that winter grain is almost always of better quality. Excepting some Southern States, winter barley has heretofore been practically unknown in this country. After three years of demonstration work, the Tennessee Winter barley is now well established in Kansas, Oklahoma, and southern Nebraska, in addition to a few successful trials that have been made in the North Central States. The results of the introduction of this barley are remarkable and very interesting. Wherever it has been grown it is now often yielding 50 per cent more to the acre than the ordinary spring barley. Besides, it has the advantage of giving much winter pasturage in seasons that are favorable for pasturing.

The unusual success of some of our introduced Swedish and Austrian pedigreed barleys is opening up the great possibilities of pure strains of this cereal, especially for malting purposes.

**DURUM WHEAT.**—In the field work on durum wheat all efforts are now being concentrated on its improvement, particularly in the development first of pure types. Much help is being given in the investigations of this wheat by the experiment stations, particularly those of North Dakota, South Dakota, and Colorado. It is so well demonstrated that the Kubanka variety is the best, considering all qualities, for the northern districts that farmers everywhere throughout the North are urged to sow only this type. A number of experiments, including baking tests, all of which have been published, have proved conclusively that it is equal to the best No. 1 hard spring wheat for making bread. The results in the sale of this wheat during the last season and so far this season have been favorable far beyond expectation. Last year about 10,000,000 bushels were exported to foreign countries, and the price on an export basis at New York City and on the Canadian border was at several times equal to that of the hard spring wheat. Probably at least 20,000,000 bushels were produced in 1905, which, after making ample allowance for seed, leaves several million bushels that must have been used for bread in this country. A good portion of this was used in Minneapolis. For the crop this year a safe estimate would be about 50,000,000 bushels, or approximately one-twelfth of the usual wheat crop of this country.

From the daily and weekly reports received from the markets, it appears that about 12,000,000 bushels of this crop have so far been sold for export. This season, at New York City, durum wheat is so

far selling uniformly at 5 or 6 cents less than the same grade of Manitoba hard. The increasing export demand from dealers who know how to judge this class of wheat ought to be strong evidence of its value to American manufacturers, and it is hoped that in the future our home consumption will increase much more rapidly.

**SIXTY DAY OAT.**—In previous reports attention has been called to the superiority of the introduced Swedish Select oat over other standard varieties throughout the Northern States. During the same time another variety of oats has been introduced from Russia, known as the Sixty Day, but which matures, however, in a little over ninety instead of sixty days. It is so much earlier than other varieties that it often escapes many fungous and insect pests that attack other oats, as well as the effects of severe periods of drought. It is very prolific as a rule, and has an unusually wide adaptation geographically.

**AMARILLO TESTING FARM.**—The testing farm at Amarillo, Tex., has been in operation one year, and the fall seeding of the second year is now finished. The operations here are to a large extent in the nature of pioneer work to demonstrate to the inhabitants of the large area of the Panhandle of Texas that agriculture can actually be conducted in that region. The experiments were conducted previously at Channing, Tex. That much success has been attained in this work is indicated in the many crops that have been successfully grown throughout that territory during the last year, the farmers having been induced to sow these crops largely through the influence of these investigations.

**INVESTIGATIONS IN CALIFORNIA AND THE SOUTHWEST.**—Experiments for the purpose of improving the quality of wheat in California have been conducted for two years at Modesto and Yuba City, Cal. In addition, seed of some of the most promising varieties of wheat used in these experiments has been furnished in cooperative trials with farmers in other States of the Southwest. From the results of the work so far it is evident that at least two of these new wheats are very well adapted to the southwestern United States and are at the same time good milling wheats.

**CHEMICAL AND BAKING TESTS OF FLOUR AND GRAIN.**—In cooperation with the Bureau of Chemistry many chemical analyses and other tests have been made of introduced grains, particularly oats and barleys, to determine their feeding value. An important piece of work has been the investigations of the comparative value of durum-wheat flour for bread making conducted for this Department by the Columbus Laboratories of Chicago.

**A STUDY OF WHEAT DETERIORATION.**—During the year a special investigation, also in cooperation with the Bureau of Chemistry, has been made to determine the causes of the deterioration of wheat from the milling standpoint. An important clue to the solution of this problem has been discovered, and when the matter is fully worked out it will, without doubt, enable the farmer to prevent the production of soft and light-colored grains that are much inferior in quality.

**RICE INVESTIGATIONS.**—A series of experiments for the thorough study of rice, its varieties, methods of handling, irrigation, etc., has been inaugurated in cooperation with the Louisiana Agricultural Experiment Station, Crowley, La., having been selected as the place of operations. More than 300 distinct varieties of rice are under experiment. The results of this season already show that a good beginning has been made in this work.



## GRAIN STANDARDIZATION.

From time to time during the past five years demands have been made upon the Department for aid in the grading and handling of grain. It has been fully recognized that this is a matter which demands most careful investigation, as both our home and foreign markets are involved. Grain grading as now practiced by the various State and other organized bodies has not been satisfactory, chiefly on account of the lack of uniformity. The Department has consistently held the ground that some system of standardization is absolutely necessary as a first step toward securing uniform methods of grain grading. With a view to eventually bringing about this standardization, Congress at its last session authorized the establishment of laboratories for the purpose of examining and reporting upon the nature, quality, and condition of any sample, parcel, or consignment of seed or grain entering into interstate or foreign commerce. After a careful study of the situation, two laboratories, all the funds at hand would permit, have been established—one at Baltimore, Md., the other at New Orleans, La. At both places the Department has received the cordial cooperation of the chambers of commerce, and is now about to enter upon the regular duties connected with the laboratories.

It will be the object of these laboratories to make a thorough study of present systems of grain grading with a view to reaching, if practicable, conclusions which will make standardization possible. It is recognized that much preliminary work must be done, and, furthermore, that special apparatus will have to be devised for quickly determining the moisture content of grain, and for conducting other observations and investigations. A moisture-determining apparatus has already been devised and is now in use at our laboratories. It is believed that improvements can be made in these devices and the Department's officers are already at work on this problem.

Recognizing the need for the closest relations with the grain trade, the Department has secured the services of an expert in grain grading, whose long experience should be of the greatest value in working out the many problems which must necessarily be connected with this important line of work.

## DRY-LAND FARMING.

Recognizing the necessity for more systematic efforts along the line of dry-land farming, during the past year important field and laboratory investigations have been arranged for, which, it is believed, will be of great value to those who have already settled or who contemplate settling in semiarid areas where irrigation is impracticable. The Great Plains area, lying between the ninety-eighth and one hundred and fourth meridians and including approximately 330,000 square miles, is one of the most important districts where this work is being conducted.

SCOPE OF THE INVESTIGATIONS.—Throughout this vast area there is not a single State experiment station, although there are several substations. The plan of the work is to establish special substations in cooperation with the State experiment stations in North Dakota, South Dakota, Nebraska, Oklahoma, Colorado, Kansas, and Texas. At these stations a series of tests will be carried on which will enable the State authorities and the Department to answer definitely important questions as to systems of cropping and farm management in this

extended area. The successful work already inaugurated with the durum wheats leads to the belief that there are several other crops which might also prove highly successful.

ADVICE TO PROSPECTIVE SETTLERS.—On account of the efforts made by land agents for the past two or three years to induce farmers to take up land in this region it seems proper to make a few cautionary statements in regard to this entire section of country. While there are great agricultural possibilities in the region, the fact must not be overlooked that farming there must be conducted along radically different lines from those of the more humid portions of the United States. Unquestionably many settlers have gone into this section who will be grievously disappointed in the near future. In spite of the fact that the past few seasons have given abundant rainfalls, the evidence is pretty conclusive that conditions will soon resume their normal state, which is one of semiaridity, and these conditions must be met in a way for which few farmers of the section are now prepared. It is needful to look with great caution upon the statements emanating from interested parties as to the probability of continued rainfalls and the growing of crops similar to those now commonly known to the more eastern sections of the United States.

#### GOOD SEED FOR THE FARMER.

Several lines of work carried on during the year have for their object the improvement of the seed upon which the farmer must depend for his crops. The investigations of seed adulterations previously mentioned in these reports have been continued, and there is every evidence that the publication of the names of firms found to be selling adulterated seed has been the means of checking the evil. In all this work the Department has but one object, namely, to protect the farmer from unscrupulous dealers who make a practice of foisting bad seed upon him. The rank and file of American seedsmen do not follow any such practices and are as anxious as the Department to protect the farmer.

A CAMPAIGN OF EDUCATION.—The Seed Laboratory has tested for both seedsmen and farmers hundreds of samples of seeds during the past year, and in this way has greatly encouraged the propaganda for good seed. A feature of the work has been a campaign of education for better seed. Cheap seed is often the most expensive thing connected with a crop. A few cents saved on each pound of alfalfa or clover seed may cost the farmer all of his work in preparing and fertilizing the ground, besides the loss of an entire season in getting the crop started. The Bureau has also been actively engaged in encouraging the good-seed work through addresses at farmers' institutes and other meetings.

BETTER GRADES OF SEED CORN.—Special work has been done during the past year in demonstrating the great importance of high-grade seed corn. The work was inaugurated to establish the great value of proper care of the ordinary seed as grown by the farmer. The main point at issue was the gain in yield due to the vitality of the seed. Actual field demonstrations have shown that, taking corn in the average—that is, corn from different parts of the United States as ordinarily saved for seed by farmers—the yield would be increased about 15 per cent if the vitality were perfect. The Department has pointed out simple methods of testing vitality that any farmer can follow, and has shown in field practice that the adoption of such methods by the farmer may increase his yield from 10 to 15 per cent. Similar work has been conducted with a number of other crops.

## WORK ON THE SUGAR BEET.

**PRODUCTION OF HIGH-GRADE STRAINS OF SEED.**—The work on breeding high-grade strains of sugar-beet seed has been very satisfactory during the year. This work is being conducted in cooperation with a number of experiment stations and private individuals. The first commercial crop of seed raised from roots selected under departmental supervision was harvested this year by a grower in Washington State and some 15,000 pounds of seed were secured, all from beets which, commercially analyzed by the Department, showed sugar contents of 21 to 22 per cent. In the work of selection rigid attention is given to every detail of size, color, form of root, shape of leaf, etc. The Department has received from a number of sources satisfactory evidence that the American seed which it is developing is highly satisfactory. One factory alone reports that the American-grown seed increased the yield 1.19 tons per acre on an area covering 391 acres, divided among 158 farmers. This seed was put out in competition with some of the most expensive grades of imported seed obtainable. As a line of work closely connected with the foregoing, the Department is carefully investigating and testing various varieties of sugar-beet seed imported, together with all strains of sugar-beet seed grown by American firms.

**SINGLE-GERM SEED.**—Very satisfactory results have been secured in the development of a sugar-beet seed which will contain a single germ. It is highly important to secure beet seed which will eliminate a considerable portion of the work of thinning. The latest returns from our investigations along this line show that our beets are averaging about 26 per cent of single-germ seed and that such seed is producing beets yielding from 16 to 17 per cent sugar. The purity coefficient is also found to be satisfactory.

The important work on fertilizers, the improvement of cultural conditions, and the extension of the sugar-beet area has been continued.

## FRUIT MARKETING, TRANSPORTATION, AND STORAGE INVESTIGATIONS.

Experimental investigations of the methods of harvesting, packing, transporting, and storing fresh fruits of various kinds have been continued during the year. The fruit transportation studies have been confined chiefly to questions involved in the transcontinental shipment of deciduous and citrus fruits of the Pacific coast to eastern markets.

**SHIPMENTS OF PEACHES AND PLUMS.**—Experimental carload shipments of perishable varieties of peaches and plums, which were allowed to remain on the trees in California until they reached much fuller ripeness than has previously been considered safe by shippers, disclosed the fact that such fruit can be delivered in eastern markets in practically as sound condition as when taken from the tree. The superiority in flavor and wholesomeness of such sound, ripe fruit as compared with fruit either overripe and decayed or prematurely picked and wilted, which makes up so large a portion of the commercial supply of our cities, was clearly apparent. Special treatment of these experimental shipments consisted simply in the quick cooling of the packed fruit from the high temperatures which it possessed when picked from the tree to a temperature of 40° to 50° F. before it was loaded in ordinary iced cars for shipment. Carloads of fruit thus treated not only required less ice in transit, but maintained more uniform tempera-



tures in the top and bottom of the car, with resultant greater uniformity of condition of contents when unloaded.

**EXPERIMENTS IN CITRUS FRUIT TRANSPORTATION.**—Along similar lines, but with closer attention to methods of harvesting and manipulating the fruit, a careful study of orange-handling methods in southern California was made. This revealed many interesting and important facts. It was found that the difference in the carrying quality of oranges from different producing districts in southern California was due primarily to the methods of handling practiced rather than to inherent characteristics of the fruit itself. Oranges free from mechanical injuries, inflicted during the various processes of harvesting, rarely showed decay during the ordinary shipment period, even when transported without icing. On the contrary, similar fruit which had suffered from inconspicuous cuts or abrasions of the skin developed from 25 to 75 per cent of decay under similar conditions. A comprehensive series of experiments, in which fruit treated by different methods was subjected to conditions favorable to the development of decay, showed that where unmutilated fruit as it came from the tree developed but 1.5 per cent of decay, similar fruit, when dry brushed, showed 4.5 per cent, and washed fruit 10.5 per cent. The whole trend of the results of the investigation thus far indicates that complexity of methods and appliances in the handling of oranges results in increased mechanical injury and correspondingly heavy losses from decay in transit.

A study of the transportation of oranges across the continent, in which different methods of shipment were compared, showed that where oranges that had been mechanically injured were shipped under ventilation, 14 per cent of decay developed. Similar fruit shipped under ordinary icing developed 7 per cent of decay, while fruit that was precooled and shipped in iced cars developed but 4 per cent. Studies of the effect of holding the packed fruit before shipment showed that, on the average, fruit shipped the first day after packing developed but 2 per cent of decay; that shipped the third day, 3.5 per cent; the fifth, 8.6 per cent, and the seventh day, 9.5 per cent. The proportion of decay developed in the mechanically injured fruit included in the above experiments was very much above these general averages, the important fact developed being that prompt shipment after packing greatly reduces the risk in transit.

**RESULTS OF FRUIT TRANSPORTATION WORK.**—These investigations have had the active support of growers, shippers, and transportation interests. In the citrus industry advantage is being taken of the results of the work. Packing houses are being remodeled and simplified, the fruit is being shipped more quickly after picking. All the interests involved have shown a disposition to take advantage of the facts developed in the investigations. One of the prominent shipping interests of the Pacific coast has estimated that the work of the Bureau along this line saved the growers at least \$250,000 in the season of 1905-6.

**STUDIES OF FRUIT STORAGE.**—In the fruit-storage investigations the cooperative study of the effect of sod and tillage on the keeping of apples has been continued with the New York State Agricultural Experiment Station, and special studies in relation to temperatures have been made in the East. The apple-storage investigations have been extended to Pacific coast fruit, considerable quantities of apples

from different California apple districts having been stored in that State and in the East for comparison. Special attention has been given to farm storage-house questions.

**EXPORT SHIPMENTS OF FRUITS.**—In the fruit-marketing investigations the experimental export shipment of summer apples from Delaware was continued, and similar shipments also of winter varieties from New York and Virginia. The problems connected with the exportation of winter apples to European countries are recognized as of the highest importance in this connection and are being studied as thoroughly as the conditions render practicable. The importance of the apple export trade to our domestic fruit industry is shown by the fact that while the crop of 1905 was estimated to be the smallest during the past decade, the portion exported was but 7 per cent less than the average of the previous five years, constituting, as nearly as can be estimated, more than 5 per cent of the estimated total crop. Fuller information as to conditions prevailing in ocean transportation and in foreign markets is greatly needed.

The exportation of eastern-grown "Bartlett" and other early pears, which began with the Department experiments in 1901, shows a gratifying increase, the total exports of pears during the fiscal year being valued at \$631,972, the larger part of which exports were of eastern-grown fruit. The beneficial effect of this export movement of pears was very evident in our markets, where good prices prevailed in consequence.

#### DEVELOPING NEW CROPS BY BREEDING AND SELECTION.

The Bureau's work in developing, by breeding and selection, new types of various crops has been very successful during the past year. A number of new sorts have been secured, some of which have been placed with growers and are now being grown on a large scale.

**NEW CITRUS FRUITS.**—The production of the new group of fruits, the citranges, or hardy oranges, is one of the most far-reaching and important triumphs which has ever been achieved as a result of carefully planned breeding experiments. Three varieties—the Rusk, Wil-lits, and Morton—have already been named, and trees have been distributed to about 2,000 fruit growers and nurserymen, principally in the Gulf States and in Oregon and Washington. Two other new varieties have been produced, having large fruits similar in appearance to ordinary oranges, and these will be named and distributed in the near future. Both of these varieties are somewhat different from the sorts previously named, and are believed to possess superior merits in certain characters. Both are large, fine-appearing acid fruits, and are very juicy. They will prove valuable, especially for culinary purposes and in the making of acid drinks. Another variety has been secured which has fairly good fruits, and gives promise of utility as a hedge plant and lawn tree. The citranges are of special value for cultivation in regions slightly too cold for the ordinary orange, and can be recommended for planting throughout the Gulf States and in regions of low altitude in Oregon, Washington, Arizona, and New Mexico.

**NEW PINEAPPLE VARIETIES.**—Three of the new varieties of hybrid pineapples have this year been distributed to a number of good growers, and next year stock of all of the new varieties developed by the Department will be available for distribution. The further experiments in this field have resulted in the discovery of six more new

hybrids which possess qualities that will render them valuable for cultivation. These will be placed with growers at the earliest possible date. All of the new varieties of pineapples are superior in flavor to the ordinary varieties, and many of them have smooth or spineless leaves, a quality of considerable value to the grower. All pineapple growers who have had an opportunity to examine and test these hybrids are impressed with their superior quality and promise.

**A NEW EARLY VARIETY OF COTTON.**—It has been claimed by entomologists and others studying the control of the cotton boll weevil that varieties of cotton are needed which will mature their entire product very early in the season, in order to permit the crop to be harvested and the stalks destroyed early in the fall. A new early defoliate variety has been produced by an agent of the Department, working in cooperation with the Texas Agricultural Experiment Station, which possesses these qualities in marked degree and which, at the same time, is a productive sort having fairly large bolls. This new variety, the present season, ripened its fruit and matured earlier than any other of the varieties tested in comparison with it, among them being the King, which is probably the earliest variety cultivated. The new variety gives promise of being of great value for planting in boll-weevil infested regions. Several other varieties of cotton selected to secure earliness and productiveness, fitting them for boll-weevil conditions, have been under experimentation, and select seed of two of these sorts, the Edson and Triumph, will be distributed this winter.

**NEW STRAINS OF CORN.**—In the corn-breeding experiments great advances have been made. One variety, which has been carefully bred in central Ohio, has, for the last four years, shown an average yearly gain of 10 bushels per acre over the original variety. Seed of this variety has been sent to numerous farmers and is giving excellent results. The breeding work with sweet corn, having as its object the improvement of strains for canning purposes, has been continued with good success. It has been demonstrated that an excellent quality of sweet corn seed can be grown, and that with good care it will germinate much better and produce a better crop than such seed as is customarily purchased by canning companies.

**IMPROVEMENT OF OATS.**—The most promising features of the oat-breeding work are the new hybrids recently developed. These are large grained and early in season, and retain the vigor and size of the late-season parent. They bid fair to excel and eventually succeed all the early varieties now grown in the central Mississippi region. Selections for disease resistance have also been made, and the year's experiments have proved that it is possible to secure smut-resistant varieties. One selection of the Burt variety has proved to be almost smut proof.

**CROPS RESISTANT TO ALKALI AND DROUGHT.**—The testing of different varieties of the leading field crops with regard to their alkali resistance is being continued and extended. Much information that will permit of a choice of crop plants and plant varieties for alkali lands and provide a solid basis for the increase of resistance by breeding has been obtained. The field investigations of crop plants in relation to alkali are being supplemented by extensive laboratory experiments. As a part of the investigations of the Bureau in dry-land agriculture, the breeding of drought-resistant strains of important field crops has been taken up in cooperation with some of the State experiment stations.



## PROGRESS IN TOBACCO WORK.

The tobacco-breeding experiments have proved particularly successful, and several of the new sorts produced in the course of the Department's experiments have already been planted extensively by tobacco growers, and are giving excellent results in increased yields of a superior grade of tobacco.

**CONNECTICUT WRAPPER TOBACCOS.**—In the work of improving Connecticut wrapper tobaccos two new hybrids have been produced—the Brewer and the Cooley. The Brewer is a hybrid of the native Connecticut Broadleaf with the imported Cuban, while the Cooley is a hybrid of the native Connecticut Havana Seed variety with the Imported Sumatra. In the hybrids the good qualities, hardiness, and adaptability to Connecticut conditions of the native varieties are combined with the superior wrapper qualities of the imported Cuban and Sumatra. The product of the hybrids has superior qualities for cigar-wrapper purposes, possessing characters which go to make up a valuable wrapper tobacco. Numerous growers have been pleased with the superior grade of tobacco produced by these hybrids and are this year growing a considerable quantity of the new varieties and selecting seed to extend their planting next year.

**WRAPPER AND FILLER TOBACCOS IN THE SOUTH.**—The experiments conducted in Florida in the improvement of tobacco varieties have demonstrated the value of this work to growers. Carefully selected strains of Sumatra have clearly shown their superiority, both in quality and yielding capacity, to the ordinary Sumatra-grown. The crops grown from select seed furnished by the Department to 12 different planters are far superior to the remainder of their crops and are decidedly the best crops of tobacco in the State. As a result of this demonstration of the value of the methods of selection and preservation of seed worked out by the Department of Agriculture, almost all of the large tobacco growers are this year using similar methods, and more than 50,000 paper bags have been used during the past summer by growers in covering the flower clusters of their select seed plants.

**MARYLAND SMOKING TOBACCOS.**—Experiments in the improvement of the Maryland smoking tobaccos have been carried on during the year in cooperation with the Maryland Agricultural Experiment Station. Selections made to secure greater uniformity and increased yields have shown striking results. The fields of tobacco grown from select seed are believed to be the best tobacco grown in the State the present season.

**MISCELLANEOUS TOBACCO WORK.**—One of the most important features of the tobacco-breeding investigations is the development of methods by which the grade and quality of the tobacco produced can be accurately determined. During the last year an apparatus has been devised for testing the burn of cigars accurately and another for testing the burn of strips of leaves. These machines will prove of great value in connection with the breeding experiments and probably also in the commercial testing of samples of wrapper tobacco. Investigations of the curing of tobacco have been undertaken, directed more especially toward the control of pole burn by means of artificial heat. Several diseases of tobacco are receiving attention, and the breeding of varieties for disease resistance gives promise of good results.

**EXTENSION OF EXPERIMENTS.**—The tobacco-breeding experiments are being extended to the tobacco-producing areas of Kentucky, Ohio,

and Virginia, and it is probable that results can be obtained in these regions as important as those produced in Connecticut and Florida. The introduction of the methods of seed selection and seed separation alone in these extensive tobacco-producing States will add many thousands of dollars to the value of the crop grown.

#### DRUG AND POISONOUS PLANT INVESTIGATIONS.

**WORK ON CAMPHOR.**—Rapid progress has been made in the investigation of camphor production, a number of camphor trees of various ages having been placed at the disposal of the Department for experimental work. More than 30 pounds of camphor were prepared, which on purification gave very favorable results. Tests of a scientific nature showed the identity of this product with that of the Orient. A careful survey of the camphor trees now widely scattered throughout Florida, and of the conditions of soil, drainage, etc., in which they occur, has made it seem reasonably clear that camphor will flourish over a large part of the area from which frost has driven the orange industry.

**STUDIES OF POISONOUS PLANTS.**—In the poisonous-plant investigations chief attention has been given during the year to the poisonous action of the so-called loco weeds in causing the loco disease in horses and cattle. The general outcome of this work has shown very clearly that these weeds are able to produce the symptoms characteristic of locoism and are unquestionably the chief cause of the immense loss to the stock-grazing interests of the West. Remedial measures are now being sought, as are also means of exterminating the weeds and methods of counteracting the poison.

#### PROGRESS IN GROWING AMERICAN TEA.

The work in South Carolina for the purpose of determining the possibilities of the commercial production of tea in the United States has progressed satisfactorily during the year. The younger gardens have given an increased yield, due in part to a change in the method of picking which was tested during the year. As a result of all influences the greatest yield during the history of the experiments was obtained, something over 12,000 pounds of dry tea. In the factory some new machinery was tested. The compression of finely ground tea into tablets was attempted with a machine of the same general type as that used by manufacturing chemists, the result being that after a few trials a hard, slightly tablet was produced which readily dissolves in hot water. The superior adaptability of this form of preparation for purposes where compactness is desired is apparent. In addition to the work in South Carolina a tea garden has been established at Pierce, Tex. The work at this point gives promise of very satisfactory results.

#### IMPROVEMENTS IN DISTRIBUTING NITROGEN-FIXING BACTERIA.

The method of distributing cultures dried on cotton for the inoculation of leguminous crops was discontinued during the year, and in its place the plan adopted of distributing pure liquid cultures hermetically sealed in glass tubes. This has been proved to be a great improvement over the old system. It is planned to distribute during the current year larger cultures to the farmers, and thus render it possible to reduce the time formerly required to develop a rich culture for inoculating leguminous crops. Many field tests in this work are

under way on large farms, and it is hoped by this careful experimental work to acquire much valuable information concerning the best manner of treatment of certain soils and crops in order to obtain successful inoculations.

#### WORK ON WATER CONTAMINATION.

The work of the Bureau of Plant Industry in the treatment of water supplies with copper sulphate for the destruction of algæ and pathogenic bacteria has passed from the experimental stage to that of actual practical use. Investigations of the use of copper sulphate in sewage disposal have indicated that in small sewage plants the use of copper will make it possible to produce sewage effluents that are entirely free from pathogenic bacteria. Work is being planned to test the efficiency of copper in connection with filtration. Additional work is to be carried on throughout the United States in order to determine the value of copper in various types of water. The copper treatment of water supplies, sewage disposal, etc., should in all cases be supervised by an expert. Before this method of purification is attempted the conditions must be worked out on a scientific basis in each instance.

#### FARM-MANAGEMENT INVESTIGATIONS.

The farm-management investigations during the past year have been carried on along two principal lines, namely, the study of farm practice and demonstrations in improved methods. The object of the first is to make a careful study of farm methods as followed by successful men in different sections of the country and representing different types of agriculture. These studies lead to the securing of data which enable the Department to assist farmers and others in planning methods of cropping and maintaining soil fertility. In connection with this work special attention has been given to crops adapted to new sections and to the relation between certain improved crops and soil fertility. Alfalfa has been found to be adapted to an important soil formation in Alabama and Mississippi, and is rapidly becoming a valuable crop of that section. This soil is heavily charged with lime. In this connection the Bureau of Plant Industry follows closely the work of the Bureau of Soils in its soil mapping. A special study has been made during the year of the practices of farmers in the East who have been successful in growing alfalfa.

**METHODS OF STORING SILAGE.**—In connection with the studies of farm practice, a special investigation has been made during the year of methods of storing silage. The kinds of crops used for silage, the cost of growing and of siloing them have all been considered.

**CONTROL OF JOHNSON GRASS.**—The farm-management investigations also deal with the question of weed control. It is believed that data have been secured which will enable the farmer to control Johnson grass and utilize it in a satisfactory way in crop rotation in the South. The secret of success in this work lies in the fact that in a Johnson grass sod left undisturbed for two or three years the rootstocks are found only at the surface. In this condition the pest is easily destroyed by shallow plowing and a little extra cultivation the next summer. This permits Johnson grass to be grown in a rotation, such as cotton, corn and cowpeas, winter oats, and Johnson grass for two years. Where the pest is allowed to grow on land that is cultivated in cotton



or corn the rootstocks penetrate deeply into the soil and eradication is extremely difficult.

**CACTUS-FEEDING EXPERIMENTS.**—Investigations into the value of cactus as food for cattle have been continued. A carload of steers were fattened on cactus and cotton-seed meal, at a cost of  $3\frac{1}{2}$  cents per pound of gain. As a feed for dairy cows 6 pounds of fresh cactus equaled 1 pound of sorghum hay when fed with a mixture of grain and mill stuff.

**OBJECT-LESSON FARMS.**—The object-lesson farms referred to in former reports have been continued. As the result of the work on one of these farms, many farmers in Alabama have sown alfalfa and are thus preparing for the advent of the boll weevil. The great advantage of pasturing hogs on alfalfa in that section has been demonstrated. In order to meet the demand for object-lesson farms in the South the system of establishing these farms has been changed. Instead of assuming close supervision of the farms, working plans are now prepared. This enables the Department to reach many more localities than were possible under the former system.

Nearly all successful farms are unique in their management. They represent systems wrought out by men of unusual energy and intelligence who have gone resolutely about discovering and utilizing the full possibilities of their land. From such men we are learning facts which when properly classified will constitute the art of farm management. These farms demonstrate the great value of intelligent management, as compared with hard work applied unintelligently.

#### SPECIAL WORK ON COTTON.

The special work on cotton which has for its object the meeting of the ravages of the boll weevil in the South has been continued along pretty nearly the same lines set forth in my last report. The cooperative work with farmers has been a special feature and has been extended into Louisiana, Mississippi, and Arkansas. This work is now carried on in the States mentioned, and in addition special attention has been devoted to Texas, which is in the heart of the boll-weevil infested territory. Experience has enabled the Bureau of Plant Industry to systematize the work so as to reach practical farmers and secure their interest and cooperation. It is estimated that through this work the Department is now reaching, directly and indirectly, in the neighborhood of 100,000 farmers in the States mentioned.

The plan is a simple one, and from its very simplicity is found to be effective. Meetings of farmers are held in different communities and arrangements made whereby representative men agree to handle a part or all of their land with the advice and assistance of the Department's agents. No radical recommendations are made in the matter of changing the existing systems, unless such systems are known to be bad. The varieties of cotton known to be best adapted for boll-weevil conditions are recommended and planted. Systems of fertilization are suggested and, wherever practicable, diversification is encouraged. The farmers who are cooperating with the Department in the work receive regular visits from our agents and, in addition, furnish weekly reports setting forth their operations and the results. At the end of the season there is, as a rule, a demonstration as to the effectiveness and value of the systems laid out as compared with the old methods. A special point which the Department makes in all this work is that no radically new methods are being urged. We



simply endeavor to have put into practice methods which are already known to be highly successful, encouraging the farmer himself to take the leading part in the work.

The breeding work, having for its object the securing of types of cotton better adapted to boll-weevil conditions, has already been referred to under the head of plant-breeding investigations. As a part of this special work on cotton, investigations of root rot have been continued, the same being largely field studies to determine the value of crop rotations in eradicating the pest from the soil. Investigations of cottons found in Guatemala and other southern countries have also been continued and some interesting results secured. Some of these cottons give promise of proving valuable for use in connection with breeding work. Having developed for a long series of years in combat with the boll weevil, they have characteristics quite different from any types of cottons which we now possess.

#### DEPARTMENT GROUNDS AND ARLINGTON FARM.

The Department grounds, consisting of 40 acres, are now in a well-developed state. During the year all the roads have been improved, a special appropriation of \$3,500 being used for the purpose. The glass houses on the grounds have been further improved and are now being used for many lines of work carried on by the Bureau.

At the Arlington Experimental Farm there are about 350 acres under cultivation. Many varied lines of work are being carried on, including the testing of foreign crops, variety tests of all seeds and plants sent out, cover crops for orchards, variety orchard and other fruit tests, etc. The farm now has a well-equipped range of glass houses for experimental work and all the newer portions of the land are being brought into good tilth by the use of proper management and green manures.

#### CONGRESSIONAL SEED DISTRIBUTION.

The Congressional seed work for the year has been conducted along practically the same lines as in the past. The number of packages of miscellaneous vegetable and flower seed sent out during the year was about 7,000,000. There has been no change in this number during the past five years.

#### FIELD LABORATORIES AND TESTING GARDENS.

At its Mississippi Valley laboratory, located at St. Louis, Mo., the Bureau of Plant Industry has conducted investigations of many of the diseases which affect forest and fruit trees in that region. Methods of treating fence posts have also been worked out during the year. Considerable attention has been given to the crown-gall disease of orchard and other fruits, with the object of finding a means for preventing the further spread of the disease. The results obtained have shown that the crown gall of the apple tree can be very largely prevented by careful attention to root grafting and by subsequent wrapping of the grafts with cloth, rubber, or paper. It has been found that this type of the disease is not contagious, while, on the other hand, the crown gall of the grape may be transmitted through the soil and may be spread by irrigation water from one vineyard to another. American varieties of grapes have been found to be very resistant to the disease,

and the most probable method of its control will consist in the growing of resistant varieties. Further proof has been obtained as to the contagious nature of the crown-gall disease of stone fruits.

In the work on various diseases of forest trees, an investigation of the diseases of red gum has been continued at various points in the Mississippi Valley. The diseases of the living tree were investigated, particularly the form of rot which destroys thousands of feet of gum timber every year after it is cut. A large quantity of timber was given a treatment as a preliminary test to ascertain whether this destruction could be prevented. The treatment showed an increase of 20 per cent in the amount of lumber cut, meaning almost a total prevention. The methods of treatment worked out are being tried by lumbermen on a commercial scale.

At the Subtropical Laboratory, Miami, Fla., the Bureau is conducting investigations of the diseases affecting tropical and subtropical plants, such as the mango, avocado, and citrus fruits. Methods have been worked out for the control of these troubles. Experiments in the propagation of tropical and subtropical fruits are also being conducted at this laboratory.

The Bureau of Plant Industry is carrying on at its Plant Introduction Garden, located at Chico, Cal., experiments in the propagation of many seeds and plants introduced from foreign countries. Trials of forage crops and vegetables suited to the Southwest are also being conducted at this garden. Twelve acres at the garden have been set aside for experimental work on European grape varieties, 4,180 cuttings having been rooted during the past season. A number of these were distributed during the past spring among the experimental vineyards maintained by the Bureau in different parts of California. Experimental work in the propagation of figs and of the pistache nut is also being carried on at the garden and with growers in the Southwestern States.

In addition to the foregoing, the Bureau is conducting an experimental farm at San Antonio, Tex. The object of the work at this farm is to test new crops likely to prove of value to the region represented, and to find the best methods of tillage by which the relatively large but irregular rainfall of the region may be utilized in the profitable production of the staple crops.

### FOREST SERVICE.

#### NATIONAL FOREST RESERVES.

The fiscal year 1905-6 was and will remain notable in the history of the Forest Service for the progress made in actually applying a National reserve policy. In area the reserves were increased during the year from 85,693,422 to 106,999,138 acres. In revenue the reserves brought in \$767,219.96, as against \$60,142.62 for the previous year and \$58,436.19 for the year 1903-4. In timber sales there were disposed of for immediate or early removal nearly 300 million board feet of lumber at stumpage prices ranging up to \$4 per thousand (besides other material to a large value), as against 96,060,258 board feet, with a maximum price of \$2.50 per thousand in 1904-5, and 69,257,710 board feet in 1903-4. The number of free-use permits granted in the same years also showed progressive increase. In the year 1904-5 the reserves were under Forest Service control only after February 1.

One fiscal year of full control has established two important facts—that the reserves advance the present interests of the people of the West, and that they will speedily pay the cost of administering them.

PUBLIC UTILITY OF THE RESERVES.

These National forests are being made useful now. The benefits which they are to secure are not deferred benefits. Through Government control the interests of the future are safeguarded, but not by sacrificing those of the present. Far from handicapping the development of the States in which they lie, the reserves will powerfully promote development. They work counter to the prosecution of no industry, and retard the beneficial use of no resource.

The wealth of the West lies, and will long lie, in what the soil will produce and in what the earth hides. Labor and capital will here find employment mainly in turning to use the farm land, grazing land, timber land, and mineral lands of the region, and in the commerce to which these great productive industries will give rise. That the reserves beneficially affect all of these industries is becoming clearer to the people of the West every day, and in consequence the policy of public administration of our unappropriated timber lands becomes more and more firmly established in the approval of a united public sentiment. Local sentiment has sometimes been unfavorable to the creation of reserves before their effect upon the public welfare was understood; but opposition has always dissolved under the test of actual experience.

The reserves do not withhold land from agricultural use, but greatly increase the amount of available farm land. Though they were made from the most rugged and mountainous parts of the West and were intended to include only land unsuited for agriculture, by the act of June 11, 1906, the right is given settlers to homestead within the reserves wherever strips and patches of tillable land can be found. At the same time, through their water-conserving power, these forests fix in regions of scanty rainfall the amount of land which can be brought under the plow, since at best much otherwise fertile land must go uncultivated for want of water. Without forest preservation much of the land now under irrigation would have to be abandoned again to the desert. Thus the promotion of agriculture is one of the main ends of the forest-reserve policy.

Mining in the West is mainly in regions surrounded by reserves or included within them; but the reserves do not impede the development of mineral resources. On the contrary, by guaranteeing future supplies of timber they are indispensable to the future development of these resources, as the great mining interests well know. They do not interfere with the prospector, who has the same right to prospect and locate in forest reserves that he has on any other part of the public domain.

Administrative control of the forest reserves is beneficial to the grazing industry. The sentiment of stockmen throughout the West is unitedly in favor of such control, because of the gain to them now that the reserve ranges are safe from overcrowding and deterioration. Thus the rights of the individual user are respected and the permanence of this great resource is assured. I wish to commend particularly in this connection the heartiness and good spirit with which the associations of western stockmen have cooperated in our efforts to enforce fair and just measures for the regulation of grazing in the interest of



all users of the forests, and in the interest of the public, to whom these forests belong. The charge of a grazing fee, made for the first time during the past year, though reasonable in view of the advantages of grazing regulation to the stockmen and the cost of reserve administration to the Government, and justly due in the interest of the public, might have been expected to cause dissatisfaction and friction. On the contrary, as soon as the reasons for the charge and the method in which it would be applied had been explained, it was generally approved and paid willingly and promptly. It was followed by no falling off in the number of stock grazed in the reserves. In some cases the associations of stockmen have voluntarily aided the Service in settling local difficulties. Their whole conduct has shown remarkable moderation, far-sightedness, and readiness to recognize and accept what is in the permanent interest of their industry, even though it involves the sacrifice of immediate personal advantage.

Finally, Forest Service administration of the reserves is beneficial alike to the lumber industry and to the timber-consuming public. There is now standing on the reserves not less than 300 billion board feet of merchantable timber. This is not locked up from present use as a hoarded supply against future needs; it is ready for the immediate demands of a developing country. It will not be rushed upon the wholesale market in competition with the cheap stumpage prices of private owners anxious for ready money, and it will not be disposed of under a short-sighted policy of utilization which would leave a gap between the end of the present supply and the oncoming of the second crop; but it is and will continue to be available, first for the small user—home-builder, rancher, or miner—and then for the needs of lumber concerns, large miners, and railroads, for which a timber supply is indispensable, and which in turn are indispensable to the prosperity of the West.

The supply of timber furnished by the matured crop now on the ground is so vast in proportion to the present demand that there might seem to be no need for caution in its use. Were no more cut than last year it would suffice for four hundred years. In the mature forest production is at a standstill, so that from the point of view of the largest possible production of timber lumbering under such methods as will insure a second crop is highly desirable. The demand upon the reserves, however, is as yet insignificant in proportion to even the present need, most of which is met by the supply from private holdings. The reserves form the heart of the western timber lands. They are generally less accessible than the private holdings which surround them, and would naturally form the last resource of the lumberman. They must be so maintained as first of all to be ready to meet the future demands of the regions in which they lie. With a growing population and expanding industries these demands will far exceed those of the present. The crucial problem of management will be to insure a timber and water supply for the great West, and to conserve the summer stock ranges. To meet it successfully will require careful foresight and the best technical information. Timber sales are now made with strict attention to the welfare of the forest, and at stumpage prices often decidedly in advance of the market.

#### THE RESERVES SELF-SUSTAINING.

The income from the reserves is as yet but a small fraction of what may be expected as they approach full utilization. Yet their adminis-



tration is already on a sound business basis. Not only are they meeting from their receipts a very large part of the cost of their maintenance; they are even now beginning to show a decided decrease in net expense to the Government. My estimate of the appropriation necessary to meet the general expenses of the Forest Service is less by \$100,000 than the appropriation of last year, notwithstanding that the total area of the reserves has been substantially enlarged by Executive action, that increasing use necessitates greater expense of administration, and that in general the work of the Service is growing very rapidly. Though the administration of the reserves forms but a part of the field of work, it may confidently be expected that within five years from the transfer of the reserves to this Department the Forest Service will cost the taxpayer nothing whatever.

In reaching this result no unjust burden will have been laid on any interest. As public property the National forests should yield to the public a reasonable return for whatever of value private individuals secure from them for their own profit. In accordance with this principle, applicants for special privileges—as rights of way, reservoir sites, power-house sites, and similar concessions—have been called upon to pay for such privileges on the basis of their commercial value. For example, in the case of water powers duly located under the State laws, but which can not be developed without the occupancy of reserve land, besides a charge for the land occupied, based on its value as forest land, a small charge per unit of power developed is made, not for the use of the water itself, which is granted directly by the State, but for the conservation of the supply which the preservation of the forests furnishes, and which, were it not for the existence of the reserve, the water-right owner could secure only by himself acquiring great bodies of forest land. Such a charge is essentially similar to the charge for stock grazed upon the reserves. It is a return for actual value received, and throws upon those who profit by public control of the reserves a share of the cost of maintaining that control.

By the wise and just provision of Congress in enacting at its last session that 10 per cent of the gross receipts from the National reserves shall be made over to the several States in which they are situated, for the benefit of the counties which would otherwise receive no revenue from a part of their area, a real grievance was redressed. Even with the present use of the reserves the benefits thus reaped from them by the communities in their neighborhood are of substantial importance. As time goes on the importance of this provision will increase, and eventually the counties will find themselves far better off than they would have been without the reserves, for private ownership followed by exploitation would have destroyed the sources of revenue by leaving little or nothing of permanent taxable value, whereas now every resource is conserved and will be made to pay its just share of income. Since the fundamental purpose for which reserves exist is to secure the best permanent use of all resources, their effect is to add to property value, and by turning over 10 per cent of their gross receipts to local use they will contribute far more to the local public needs than the taxes they would pay if they were private property.

Protection of the reserves from fire has been the most important task laid upon the Forest Service. It is cause for congratulation that the loss by fire during the year was so slight. Indeed, the saving which resulted from the organized care of the reserve force was undoubtedly worth more than the whole cost of administering the

reserves. Only about eight fires of any consequence occurred on the reserves during the calendar year 1905, a season of extreme dryness and one in which under ordinary circumstances the damage from fires should have been unusually large. This small number was due in large part to the system of patrol, which leads to the discovery of fires before much damage has been done. So far during the calendar year 1906 the damage from fire has been extremely small, even in comparison with that in 1905. Increased efficiency of the patrol system, combined with favorable climatic conditions, has led to this favorable result.

#### WORK OF THE YEAR.

##### FOREST MANAGEMENT.

The progress made by the Forest Service in the brief period of seventeen months, during which it has had charge of the reserves, in introducing management upon a vast field of operations in virgin forests of varied types, compares favorably with anything that the history of forestry can show in any country. From Minnesota to southern California and from Washington to New Mexico, reserve timber is now being cut under regulations looking to a second crop. With larger experience the methods now applied will doubtless be found faulty in some respects, and with opportunity for more intensive use which the rising value of timber will afford, much more satisfactory results will be possible; but the important fact is that, confronted with a problem of unexampled magnitude in its kind, the Forest Service proved able to substitute conservative for destructive use, while greatly increasing the use itself.

Live timber is cut on the reserves under stipulations based on actual study of the forest conditions to protect the forest and the water supply from injury. Piling of the waste left by logging is always required, a diameter limit is set to prevent too heavy cutting, seed trees are left where necessary to provide for reproduction, full utilization of all salable material is compelled, and young growth is protected from injury. All this the purchaser is under contract to perform, under the supervision of the forest officers, who are held to efficiency by systematic inspection. Yet in spite of these requirements, which slightly reduce the profits of lumbering to the purchaser, record stumpage prices have often been obtained, and the average price realized has been far above that usually paid in the same regions. Living trees to be cut are marked beforehand by the forest officers, who also scale the lumber before it is removed.

Though some large sales of timber have been made in regions where great quantities of mature forest were available and exposed to deterioration, the constant policy has been to encourage the small user. Besides the free-use permits, in more than 99 cases out of every 100 the sales were of less than 5 million board feet.

Receipts for the sale of timber on the reserves were nearly \$250,000, while the contract sales of the year reach a total of over \$500,000. Five years is the longest period allowed under these contracts in which to cut the timber sold. Timber which can be harvested with profit only by large operations and with a heavy outlay for the construction of a milling plant or means of transportation, or both, must necessarily be sold under a contract extending over several years; but no sales are made permitting the speculative holding of timber against a rise in market price.

The largest totals of sales by States were in South Dakota (73 million board feet), Wyoming (71 million feet), and Montana (over 53 million feet). In the latter two States heavy lodgepole pine forests are ready for the ax, but difficult to lumber from their inaccessibility. At the same time a sudden demand for lodgepole pine railroad ties has opened a market for this timber and made it possible to sell by large contracts under conditions which will permit a second cutting after thirty or forty years. In South Dakota a special reason exists for pressing the sale of timber with the utmost energy. By the ravages of a bark beetle great quantities of timber are being destroyed, and the annihilation of the entire forest of the region is threatened. Only by extensive cutting of infested trees can the spread of the beetles be checked and the damaged timber be utilized.

In Colorado and Arizona sales of timber totaled over 27 million board feet for each State, and in Utah and California over 10 million. In Colorado and Utah these sales were mainly of fire-killed timber, largely used in mining. In Arizona large quantities of mature accessible timber permitted extensive cutting without injury to the forest. In other States cutting was comparatively insignificant in amount, save in Idaho, where nearly 9 million feet were cut.

Little difficulty was experienced in preventing timber trespass upon the reserves. Where such trespass occurred the full value of the timber taken was recovered. Practically no loss was sustained from theft.

#### COOPERATIVE MANAGEMENT.

The Forest Service continues to receive applications from private owners for assistance in introducing forest management upon their holdings. So far as possible the Forest Service will give aid in this work as in the past, since it is plainly in the public interest to promote the practice of forestry among private owners on business principles. It is significant that while at the first it was necessary to prepare a working plan for every timber tract before recommendations for conservative management could be made, during the past year, out of 54 timber tracts examined, it was possible on 43 to outline at once a system of management and the regulations to put it into effect. Working plans were made during the year for 6 large tracts in New York, Kentucky, Michigan, and South Carolina, and for 100 woodlots in 16 States.

In the woodlot work, which assists small owners, particularly farmers, to make the best use of their woodland, special attention was given to the Middle West. Very different problems are here presented from those of the Eastern States, hitherto the main field of woodlot study. As the need of timber becomes more pressing, the yield from these small forest areas, which nevertheless in the aggregate form a large part of our total woodland area, will become increasingly important. On the whole, the farmer knows how to utilize his woodland far less intelligently than any other part of his farm. If he can be brought to an early realization of the future value of good timber and knowledge of how to grow it, great benefit will result, both to the farmer and to the community, which later will stand in need of every available supply.

Cooperative forest studies were carried on during the year with the States of California, New Hampshire, and North Carolina; with the Office of Indian Affairs of the Department of the Interior, on the



Wisconsin Indian Reservation; with the War Department, on the military reservation in New Mexico; and with the Hydrographic Division of the United States Geological Survey, upon the Potomac River watershed. The production in Wisconsin and Minnesota, in cooperation with the Northern Pacific Railroad, and the effect of sulphur fumes from smelters on neighboring forests in Tennessee, in cooperation with private forest owners and with the Bureaus of Chemistry and Entomology, were also studied.

#### FOREST EXTENSION.

The field of forest planting in the United States broadens with every year. In the East the economic conditions are bringing rapidly nearer intensive forest management, which will involve extensive planting, both to stock the land fully and to shorten the interval between crops. In the Middle West the rising value of lumber is tending to make the growing of trees profitable on land now in pasture or under the plow. Knowledge gained by past investigations of how to make trees grow under adverse conditions opens enlarged possibilities to private owners in the more arid parts of the far West. By far the most important part of the field, however, is that of reserve planting. Here in the future a gigantic task will be presented, upon which the Forest Service has already begun a preliminary attack. Planting will furnish a future timber supply, improve drainage basins, and replace inferior species with more valuable trees. Of the 107,000,000 acres of reserves enormous areas are partly or wholly unforested.

In the Middle West alone are 5 reserves, aggregating over 750,000 acres, which are practically treeless and on which planting is now under way. Doubtless future additions to the reserves will still further increase the task. While some of this land may never support trees, the public welfare will eventually demand that the larger part of it be forested. Unaided natural reproduction can never accomplish the task in time. As the need for wood and water increases, planting on a scale as yet entirely unthought of in this or any other country will be carried on.

For private planting the two most serious obstacles to widespread activity are the high cost and the poor quality of both the nursery stock and the tree seeds now commercially obtainable. In some cases eastern tree planters have been compelled to import from Europe nursery stock of American trees, and adulterated seeds are common on the market. It is not possible for the Forest Service to supply nursery stock for private use, but it is doing what it can to aid the planter by tests of the purity and germinative powers of seeds furnished by different dealers, and by information as to prices at which seeds and stock may be obtained in different regions.

For planting on the reserves the Forest Service must raise its own material. Six planting stations are now established, with an annual capacity of 6,000,000 seedlings. Yet to plant 1 square mile requires more than 700,000 seedlings. Though four years have passed since the first nursery station was established, the work as yet done has been hardly more than experimental, and in the newer nurseries few of the seedlings are old enough to plant out. To meet the needs of the reserves, preparations for planting must be made on a vastly greater scale.



As a first step, nursery sites will be established at rangers' headquarters on all the reserves. As rapidly as possible the reserve force will be trained to carry on this work, and nursery stations will be multiplied.

The real progress made toward reserve planting appears not in the number of trees set out or the present capacity of the stations, but in the fact that practical methods of doing the work at reasonable cost have been found. In spite of the high cost of labor in this country, an acre of land can now under ordinary conditions be planted to forest by the Service almost as cheaply as the same work is done in Germany. The whole problem of successful forest planting under the conditions of aridity, elevation, lack of transportation facilities, and scarcity of labor, combined with the lack of any experience which could guide to right action, was one of extreme difficulty. Though much yet remains to be done before a perfected system of planting will have been secured, the work now done amounts to a demonstration that success is within reach. This in itself is no small achievement.

#### COOPERATIVE PLANTING.

The Forest Service cooperates with private owners to secure forest extension by preparing planting plans for them. Two years ago the average size of the planting plans made was 68 acres. Last year it was 310 acres. This is significant of changing conditions. Increasingly as the necessity of provision for the future needs becomes plain, large owners are seeking the cooperation of the Service. A number of railroads have begun to plan for tie production from planted timber; coal companies are preparing to utilize waste land, and cities are seeking to improve their watersheds and at the same time derive a revenue from the land held for watershed protection.

Examinations were made of over 300,000 acres on which the owners wish to consider planting, and detailed planting plans were made for over 10,000 acres in 19 States.

Cooperation with other Departments, by the preparation of planting plans, included the War Department, the Bureau of Fisheries of the Department of Commerce and Labor and the Reclamation Service of the Department of the Interior.

#### DENDROLOGY.

The investigation of turpentine methods was pushed along lines which promise important economic results by diminishing the wound inflicted on the tree and greatly prolonging the period during which a tract may be worked. A chemical study of the turpentine from different species of pines (conducted in cooperation with the University of North Carolina) is under way to learn which species furnish the most valuable yield.

Studies of forest distribution and resources were continued. The experimental basket-willow holts demonstrated the success of the cultural methods advocated by the Service by producing a crop of rods of the finest quality. Analyses of willow barks established their value for use in tanning. By the identification of many samples of woods valuable information was furnished wood users.

#### FOREST PRODUCTS.

An important means of reducing the drain upon our forests is the treatment of wood by seasoning, by the use of chemicals, or by both

combined, to make it last longer. Careful experiments are under way to determine the most effective and economical methods of treating railroad ties, telephone and telegraph poles and cross arms, and fence posts. Material cut at different times of the year, seasoned at different times of the year, and by different methods, and treated by different processes is being tested in service to find out how it can be made most durable.

Wood distillation to utilize the waste product of lumbering, and the suitability of untried woods for making paper pulp, were made the subjects of special studies.

Over 12,000 tests of the strength of timber were made. The woods tested include loblolly pine, red fir, western hemlock, Norway pine, tamarack, white and red oak, and eucalyptus. By these tests, which show the suitability of the various kinds of wood for different uses, both timber-land owners and those who employ wood in building and manufacturing have received great benefit. New woods have been brought into use and economy in the use of material has been promoted. The present facilities for this work are inadequate, and it is important that a special laboratory be provided at Washington.

By statistical study of the production and consumption of lumber in various forms and compilation of the various grading rules now in use, information greatly desired by the lumber trade but never before obtainable was gathered, better conditions were promoted, and light was thrown on the highly important question of the probable duration of the country's lumber supply. Special studies of the manufacture of cooperage stock, of vehicles and implements, and of boxes, and of certain kiln-drying methods, gave results of decided value both to the manufacturers and to timber-land owners. Wood as a paving material was also studied, and experiments were started to discover the best kinds of wood to use and how they should be treated and laid.

#### BUREAU OF CHEMISTRY.

The activities of the Bureau of Chemistry during the year included a great variety of investigations.

##### EXAMINATION OF BUTTER, MILK, AND CREAM.

More than 800 samples of butter were investigated, to see if they complied with the requirements of the law relating to renovated butter. A study of the effects of cold storage upon the chemical composition of milk and cream was inaugurated, to determine the length of time during which such products can be safely kept in cold storage.

##### CEREAL INVESTIGATIONS.

The effect of environment upon the content of sugar in Indian sweet corn was studied. The almost universal use of sweet corn for food throughout the country renders such an investigation of peculiar interest to consumers as well as to producers. A single variety of seed was planted in different localities from South Carolina to Maine, and the quantity of sugar in the product was carefully determined. At the same time meteorological data were secured which are utilized in determining the effect of environment in all of its factors upon the composition of the product. It was found that within twenty-four hours after harvest, if exposed to ordinary temperatures, a very considerable percentage of the sugar has disappeared from the grains of

the corn. This fact has led to the observation that it is necessary to market the product as soon as possible after harvest, and meanwhile to keep it at as low a temperature as can be secured.

Studies looking to the improvement of the different varieties of Indian corn, by selection based upon analytical data, were undertaken. These studies are a continuation of those conducted the preceding year upon the effect of environment on the chemical composition of the sugar beet. In all, over 3,000 analyses were made of cereals in the prosecution of the above investigations. These investigations also include the effect of environment upon the chemical composition of barley as related to the brewing industries.

#### STUDY OF DENATURED ALCOHOL.

An important investigation was also begun upon the economic production of alcohol from various raw materials in relation to the production of denatured alcohol for industrial purposes. The object of this investigation was to discover the value of various waste materials of factories—wood, molasses, sweet potatoes, cornstalks, etc.—in the production of alcohol for denaturing. This work is likely to prove of great value to our farmers in developing new sources of income from the production of denatured alcohol for industrial purposes.

#### TESTING OF SUPPLIES FURNISHED UNDER CONTRACT.

In the Contracts Laboratory, the object of which is the examination of materials furnished to the different Departments of the Government under contract, 69 samples were examined for the War Department, 19 for the Navy Department, 65 for the Department of the Interior, 36 for the Treasury, 73 for the Post-Office, 1 for the Department of Commerce and Labor, 73 for the Government Printing Office, and 59 for the Department of Agriculture. These examinations were of the most rigid character, and the result of the work has been to secure a much higher quality of material than was formerly supplied under the contract system.

#### EXAMINATION OF DRUGS.

The examination of drugs has been particularly fruitful during the year. Five hundred and fifty-three samples were examined for purity and quality. A large part of the work of the Drug Laboratory has been in connection with the Post-Office Department for the purpose of suppressing traffic in fraudulent preparations transmitted through the mails. As the result of these investigations a large number of fraud orders have been issued forbidding the use of the mails for such purposes. Other important investigations were undertaken in the testing of chemical reagents, of oils and essences, and of plant drugs.

#### ANALYSIS OF WATERS, INSECTICIDES, AND CATTLE FOODS.

The examination of waters used as beverages has been continued, and also the analysis of waters used for irrigation. Thirty-nine samples of insecticides were investigated during the year. Studies were made also of the lime-sulphur-salt wash and allied mixtures. One hundred and fifty-four samples of cattle food were analyzed to determine the quality of the cattle foods sold upon the markets. Studies



were also made of the injurious effects of fumes from smelters upon vegetation, and testimony was given in the courts relating thereto. It is evident that the sulphurous acid fumes produced in most smelters are of a character to injure vegetation and also animal health in a region very widely extended about the factory. It appears probable that in the near future smelters will be required to convert the sulphurous acid into sulphuric acid or some other substance which will not cause the injuries above mentioned.

#### STUDY OF TANNING MATERIALS, PAPER, AND TURPENTINE.

The study of tanning materials was continued, especially of the Sicilian sumacs. The effects of different tanning materials upon the character, quality, and durability of leather were investigated. Investigations of great importance, not only to the various Departments of the Government but to the people in general, are those relating to the character of paper used for public records. Investigations have been continued respecting the composition of turpentine distilled from wood and its relations to the ordinary turpentine.

#### FOOD INSPECTION.

The food and drugs act, June 30, 1906, imposes upon the Department additional duties of a most important character. The two chief purposes kept in view by this act throughout all its sections are, first, to prevent the introduction of any injurious or debasing substance into foods or drugs, and, second, to secure the correct labeling of all food and drug products. This act applies to all interstate and foreign commerce in all foods and drugs, and also to all imported meat food products. The proper enforcement of this act must prove of immense benefit to all the people of this country in securing freedom from adulteration and fraud. Regulations providing for the administration of the law have been carefully prepared, and 30,000 copies have been distributed throughout the country.

The inspection of imported foods at the ports of entry has been extended, especially at New York, Boston, and Philadelphia. The earthquake and fire at San Francisco in April unfortunately destroyed our laboratory at that port. It is hoped that this enforced suspension, however, will not be of long duration.

Five thousand seven hundred and forty-nine samples of imported food products were examined during the fiscal year. Of the 1,246 samples which were found not to comply with the law, 531 were released without prejudice because it was evident that no intent to defraud or deceive the people of the country existed; 577 were admitted after being relabeled so as to comply with the provisions of the law; 138 invoices were required to be reshipped beyond the jurisdiction of the United States. In addition to the above number of samples, 8,735 inspections were made upon the floors of the appraisers' stores.

The effect of the food-inspection law on foreign commerce has been most salutary. In many cases kinds of food products which were formerly very generally misbranded are now found to be almost universally free of suspicion. There has been a very decided improvement in the quality of imported food products, due to inspection.



## FOOD STUDIES.

The Division of Foods has also conducted special investigations into the extent of domestic adulteration of food products and an investigation of tropical and subtropical fruits, as well as of fruits of domestic production.

A very extensive investigation made to determine the character of distilled liquors, both those imported into the United States and those of domestic manufacture, has been practically completed.

The study of the effects of colors, preservatives, and other substances added to foods has been continued during the year, and most valuable data relating thereto are now being prepared for publication. This investigation is particularly valuable because the experiments are made upon human beings.

## MICROSCOPIC WORK.

The microscope has become one of the most valuable adjuncts in the examination of food products and materials used for technical purposes. Micro-chemical investigations have been largely made in the work of the Bureau of Chemistry and have extended not only to foods but also to leathers, papers, tanning materials, and bacteriological examinations. The total number of samples examined during the year was 1,067. The bacterio-chemical work has been of extreme importance. This is especially true in connection with the work authorized by Congress on the effects of cold storage upon wholesomeness of food products. Particularly in investigating the relative merits of drawn and undrawn fowls when placed in cold storage, the bacterio-chemical examination is of vital importance. Studies have therefore been made to determine whether the bacteria of the intestinal tract migrate to the flesh of the fowl during the period of cold storage, and, if so, what chemical changes are produced thereby. The bacterio-chemical investigations have extended to a large number of other subjects, particularly to the chemical changes which take place in milk, cream, and evaporated and condensed milks, and to the general changes of a bacterial character which foods undergo on keeping.

## BUREAU OF SOILS.

Underlying all attempts to improve the general agricultural welfare of the country lies the necessity for a correct knowledge of the character and variety of its soils. Such knowledge is fundamental, and without it no great progress can be made in securing further diversification of crops, the introduction of new crops, or the more economical production of the great staples now known.

## THE SOIL SURVEY.

Since 1899 the Bureau of Soils has been conducting an investigation of the soils of the United States which will ultimately result in a thorough familiarity with the vast, varied, and but partially appreciated soil resources of the country. The purpose of this work is to ascertain the variety and extent of the chief characteristic soils of the country, to determine the crop or crops which can be raised to the best advantage upon each of these soils, and to discover what peculiarities of soil management are best suited to secure the maximum results on each soil in different and widely separated localities.

## EXTENT OF THE SURVEYS.

During the fiscal year 1906 soil surveys covering 19,341 square miles, or 12,370,240 acres, were made in 29 States and 2 Territories. In all, to June 30, 1906, 251 different surveys have been made in 43 States and 4 Territories, covering a total area of 118,687 square miles, or 75,959,680 acres. These surveys have covered not only a wide range of soil and climatic conditions, but also the typical soils upon which the chief staple crops as well as many new and special crops are being produced.

## THE PROBLEMS ENCOUNTERED.

The work of the soil survey in 1906 and in preceding years, while dealing chiefly with the characteristic soils upon which the staple crops—corn, wheat, cotton, grass, etc.—are produced in different sections and under different conditions of soil and climate, has also encountered many specific problems of wide interest and application. The opening of large areas for agricultural occupation has necessitated in several States a study of the existing soil types in order that the appropriate crops for production upon each might be determined. The widespread interest in the agricultural capabilities of undrained lands in many sections has led to demands for surveys which shall determine the character of crops to which such soils may be farmed after reclamation. The breaking up of large dry-farmed ranches for more intensive forms of agriculture under irrigation has also necessitated surveys which could be used as a basal guide in crop selection. The extension of crops like tobacco and alfalfa into entirely new areas whose soil adaptations were formerly unknown has been made possible by the soil surveys. The introduction of new crops has been accomplished along the lines suggested by the surveys. One of the chief purposes and uses of the surveys has been to aid individual farmers in the selection of land suited to general or special crops in regions unknown or but partly known.

## THE SOIL RESOURCES OF THE COUNTRY.

In the work of the soil survey, since its inception in 1899, 461 distinct types of soils have been encountered. Some of these types are of great extent, covering areas measured by thousands of square miles. Still others are of local extent and distribution. Some are distributed over a considerable range of climatic environment. Others are so restricted that they may be said to lie in a single climatic belt. The great striking fact, however, is that with such a great variety of individual soils only about a dozen important crops are now produced in the entire country. Again, the same crop is produced with the greatest diversity of success or failure upon a great variety of soils, to some of which the crop is well suited while upon others it is annually produced at a loss. Before the farmers of all sections of the United States can reduce agriculture to a basis of permanent business success the knowledge of these facts must be thoroughly disseminated and fully understood.

It has been found that in addition to the broad subdivision of the country into a humid region, an arid region, and a rather indefinite semiarid region, there are at least thirteen grand divisions among the soils which may be termed soil provinces. The soils of the Atlantic and Gulf Coastal Plains differ materially from those of the Piedmont Plateau. The soils of the glaciated region of the Northern States are

materially different from those of the limestone valleys, and from the alluvial bottom lands or the residual prairies of the Western States. Still greater differences exist between the soils of the Pacific coast valleys or the Great Interior Basin and those of the Eastern State provinces. All of these differences have their deep significance in the selection of crops and in the management of the soils. Even within single provinces there are groups of soils which differ profoundly from all others, and these differences must be recognized and their crop signification understood. Each series also ranges from the coarsest sandy and gravelly types or individuals to the finest grained clays. No two of the numerous individual soils possess exactly the same characteristics, and no two are, therefore, adapted in the same degree to exactly the same crops nor to the same treatment and handling.

When all of these differences have been ascertained, and when the significance of these differences comes to be understood, the country will be able by the introduction of new crops and by greater specialization in crop production to increase greatly the agricultural efficiency of every tilled acre.

#### DEMANDS FOR THE WORK.

Each year brings an increasing number of requests for survey work in particular localities to serve a great diversity of interests. The development of new lands in the United States has not ceased and the need for specific and unprejudiced information concerning soils in newly developed regions has become widely recognized. The extension of tobacco culture through certain portions of the Gulf States has led to numerous requests for surveys to locate areas of soil where the Cuban type of filler tobacco may be grown successfully. Only a few soils are suited to the production of this leaf, and unless such soils are found in an area the attempt to introduce the crop must result in failure. The growth of the fruit interests in all sections of the country has led to widespread demands for surveys to determine what soils are peculiarly adapted to the growing of apples, pears, peaches, grapes, or citrus fruits, the location of these soils, and their extent. The depression of farm values in some sections has called attention to the possibility of rehabilitating these farms and soils through the introduction of new crops and of new methods, and surveys are requested to furnish guidance along these lines. New areas for the production of market-garden and truck crops are being developed along the Atlantic and Gulf coast lines, and surveys have been requested for many of these areas. The northward spread of the culture of rice upon prairie lands has given rise to requests for surveys to indicate soils and regions where this crop might be introduced.

As a result the Bureau of Soils has always on file requests for several times as many surveys as can be made during any one year, and the completion of each year's work is accompanied by an increased rather than a diminished volume of requests. While such a condition is gratifying from the standpoint of public appreciation of the value of the work, it is embarrassing and unsatisfactory because of the necessity for selecting among so many requests of almost equal urgency those areas which may be undertaken each year. The public demand for the making of these surveys and the constant application for survey reports, not only for areas which have been surveyed, but also for those which have not yet been undertaken, both evince the necessity for a considerable increase in the volume of soil-survey work in the immediate future.



## RECLAMATION OF ALKALI LANDS.

The progress of the work on the several alkali reclamation tracts during the fiscal year just closed has been gratifying, both as regards the immediate success of the experiments and as regards the stimulating effect that these results have had upon private initiative in the work of reclaiming similarly affected neighboring lands.

## PROGRESS ON THE UTAH TRACT.

On the Swan tract, near Salt Lake City, Utah, the work consisted largely of experiments with various crops, as the removal of alkali had practically been accomplished by repeated flooding in 1903 and 1904. The thrifty growth of alfalfa and of other crops, not perhaps as sensitive to alkali, clearly demonstrates the great changes that have taken place in the soil since it has been treated. Formerly this field presented a desolate appearance, with large areas heavily incrustured with alkali. The success of this experiment can not but be far-reaching in its influence upon the alkali question in the Salt Lake Valley.

## COMPLETION OF WORK AT FRESNO.

Our earlier work on the Toft-Hansen tract, near Fresno, Cal., had freed the upper layers of soil from alkali, and very satisfactory crops had been grown; however, while the alkali question had been solved, a constant source of danger was the high ground water, which rises very rapidly in this district after water is turned into the canals each spring. The original drainage system was not very deep, and the question of keeping the drains free from sand and silt proved serious. In order further to experiment with the lowering of the ground water, it was thought advisable to install a new drainage system. This was completed in November, 1905. The entire drainage system was lowered from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet, and the ground water is now kept at a safe depth, not only under the land drained, but under adjoining farms to the extent of 200 acres.

The success of this work has proved of great value to the farmers of the alkali and seepage-infested district about Fresno, and many have signified their intention of undertaking work similar to that carried on by the Bureau of Soils. At the close of the irrigation season of 1906, the Bureau's work in the Fresno district will close, as the owners of the land are well pleased with the reclaimed condition of the soil and the success of the newly installed drainage system.

## CONTINUATION OF THE WORK AT YAKIMA, WASH.

In Washington, in the Yakima Valley, the results have not been quite as satisfactory as was hoped when the work was commenced. While parts of the Gervais tract, near North Yakima, have been thoroughly reclaimed, and produced in 1905 a heavy crop of hay valued at \$160, other parts of the tract have not yielded to treatment so readily. That some parts of the tract still contain appreciable quantities of black alkali is evident from the crop returns, from repeated chemical tests, and from the characteristic dark stains in the soil. It is somewhat difficult to explain the retention of alkali by the soils of the Yakima Valley. It is well known that hardpan retards the movement of alkali, and it seems probable also that the volcanic ash soils of this valley may have a high absorptive capacity, enabling them still to retain injurious quantities of black alkali in spite of repeated flooding.



Good lands in this region produce such profitable crops that the exact treatment for the alkali lands should be ascertained if possible, even though the total cost of reclamation be great as compared with other districts.

#### RAPID COMPLETION OF THE RECLAMATION WORK IN ARIZONA.

The record of the Cummings tract, near Tempe, in the Salt River Valley, Arizona, is excellent. The drainage system was installed early in 1904, but no water was available for leaching out the alkali until many months later. When the water supply became more abundant the removal of the alkali was comparatively simple. At the present time 14½ acres support a fine stand of alfalfa, planted in November, 1905, while the remainder has produced a heavy crop of barley. The owner of the land is fully satisfied with the showing of the crops and only awaits the seeding of the small tract to alfalfa before accepting the land according to the contract originally agreed upon. As the water supply of the valley is still further increased by the extensive operations of the United States Reclamation Service in constructing storage reservoirs, the subject of eliminating alkali and controlling the ground water will become more important, and the Bureau is very fortunate in having undertaken and completed this work at such an opportune time.

#### RESULTS IN MONTANA.

The showing of the O'Donnell tract in the Yellowstone Valley, Montana, is fully as good, if not better, than the one just mentioned. The drainage system was installed during 1904, but too late to allow any flooding. During 1905 the land was continuously flooded for several months. From the outset the drainage system worked perfectly and large quantities of alkali were removed by the drainage water. Tests made in June, 1906, showed that the alkali content to a depth of 4 feet had decreased to approximately 0.2 per cent over the entire tract. In 1904 the soil contained more than 1 per cent to a depth of 4 feet, largely concentrated in the first and second feet. The comparison shows the extent to which the alkali had been removed by a single year's flooding. Early this year the soil was put in order and seeded to oats. This crop produced a yield that compared favorably with the most productive lands in the valley.

Since it has been shown that alkali can be removed from the soils in the Billings district the outlook is most promising. One of the worst alkali and seepage areas has been included in a drainage district, and a deep outlet ditch now constructed will serve to carry the surplus water from smaller, more detailed drainage systems in individual fields. Smaller local drainage systems are also being formed by private enterprise.

#### NEED FOR CONTINUING THE DEMONSTRATIONS.

In carrying on the work in reclaiming alkali soils we have had many different conditions to meet and local difficulties to overcome. At each tract the character of the soil differed from that of the other tracts, and at no two places are the alkali conditions nor the details of attacking the problem the same. This makes plain the wisdom of extending the work to other affected districts in order that full and exact plans may be placed in the hands of the farmers suffering this common evil of the arid West.

Already urgent requests for the extension of this work are on file in the Department, and in view of its great economic importance it is the intention to follow the completion of the present demonstrations with the reclamation of small tracts in some other of the worst affected sections. There is no one soil problem more important to a large number of our western farmers than this, and none, happily, that is capable of such quick solution or that involves so great and so certain immediate increase in their wealth.

#### TOBACCO INVESTIGATIONS.

During the fiscal year just closed the Bureau of Soils has continued its investigations for the improvement of tobacco in Texas, Alabama, Ohio, Virginia, and Connecticut.

#### EXPERIMENTS IN TEXAS.

The tobacco grown in Texas during the preceding year was distributed to the trade for the purpose of ascertaining its commercial value. In all 300 samples were sent out, and from the numerous replies received it can be positively stated that the tobacco produced in Texas meets the requirements of the trade as a high-class domestic filler. About 200 acres are now being grown on the Orangeburg soils in Nacogdoches, Anderson, Houston, and Montgomery counties in east Texas, while in central Texas, in Lavaca and Lee counties, experiments were conducted on similar soils. The industry is now assuming a commercial status, as a ready market has been created for the leaf. Great interest has been shown by the trade, by railroads, and by local interests in east Texas as a tobacco-producing region, and, with the promising beginning made in the counties mentioned, there is every reason to believe that this section of the State will soon be recognized as an important factor in our tobacco industry.

#### PROSPECTS IN ALABAMA.

The investigations for the production of filler leaf in Alabama have this past year been extended into Dallas County, in the southern part of which the Orangeburg soils appear. In Perry County the acreage increased over 100 per cent. A ready market has been found for the product, and this has proved a stimulus to the growers. The tobacco produced is similar in quality to the Texas and Florida leaf, and the cost of production is a little less.

#### FERMENTATION AND SELECTION IN OHIO.

In Ohio the work of introducing the bulk method of fermentation has been continued, and over 25,000,000 pounds of tobacco have been fermented according to the method prescribed by the Bureau of Soils. It has taken a period of five years to accomplish these results, and the system is now so well established in Ohio that the packers should be able to proceed without further supervision by our experts. Besides the fermentation work, the work of introducing Cuban seed filler in Ohio has been continued, 25 acres having been planted by the farmers under the direction of the Bureau. This was contracted for with local packers at prices ranging from 18 to 20 cents a pound.

In Ohio, also, cooperative experiments have been conducted with the Bureau of Plant Industry in the selecting and breeding of improved types of tobacco, with a view to securing types of leaf giving a larger

yield and having a uniform quality. Selections were made of Zimmer Spanish, Little Dutch, Ohio Seedleaf, and Ohio Cuban. It is believed that by this method of selection of seed native varieties of Ohio tobacco may be greatly improved, since where so many varieties are grown, as in the Miami Valley of Ohio, there is great danger of their becoming mixed.

#### EXPORT TOBACCO IN VIRGINIA.

The experiments begun in Virginia in 1904 with heavy fire-cured tobacco have been continued during the past fiscal year. In the first year of this work it was demonstrated that by the use of carefully selected fertilizers the profits in growing this type of leaf could be increased considerably as compared with those obtained by the Virginia farmer. During the past year the same treatment of the same land was followed, and, between the two crops of tobacco, rye was sown as a cover crop and plowed under in the spring of the year. The results obtained show the accumulative effects of the fertilizer and cultural methods used. The land was divided into 3-acre plats. On one the fertilizer practice common to the locality was followed, on the second a slightly better brand was applied, and on the third a still more expensive application was made.

The cost of production of the three plats was respectively \$44.50, \$63.60, and \$85.49, which shows a net profit of \$15.63 on plat 1, \$37.01 on plat 2, and \$40.10 on plat 3. It is interesting to note that the same plats of ground receiving the same treatment in 1904 netted profits of \$5, \$21, and \$24, respectively, showing gains in 1905 over 1904 of \$10.63, \$16.01, and \$16.10, respectively. These results are highly significant as indicating what may be done in this important tobacco district by the use of such methods as are practiced, for instance, by the Connecticut Broadleaf growers.

#### BEGINNING OF EXPERIMENTS WITH VIRGINIA BRIGHT TOBACCO.

Investigations for the improvement of the Bright tobacco of Virginia were also begun during the past fiscal year (ended June 30, 1906), in cooperation with the Virginia Experiment Station, the experimental field being situated near Chatham, in Pittsylvania County, the center of the Bright tobacco belt of Virginia, and within 20 miles of Danville, the largest market for this class of tobacco. The experiment is still in progress, and it will be impossible to report definite results until next year.

#### CONNECTICUT SHADE-GROWN TOBACCO.

In the Connecticut Valley the work of producing, under shade, a wrapper leaf having all the qualities demanded by the trade has been continued in connection with the breeding experiments of the Bureau of Plant Industry. Eleven selections were taken in a 4-acre tent, seven from Sumatra seed and four from Cuban seed of the third generation in Connecticut. The yield of Sumatra ranged from 1,445 to 1,612 pounds per acre, and of Cuban from 1,134 to 1,384 pounds per acre. Out of these eleven types there have been selected two types of Sumatra and one of Cuban seed that appear to meet the demands of the trade.

Besides the area in the experimental tent of the Department, there were grown by private planters during the year about 120 acres under cloth shade, both Cuban seed and Connecticut Broadleaf being planted.



This is a slight increase over the acreage planted the preceding year and indicates that the trade is becoming interested in the shade product. One firm growing Broadleaf sold the tobacco for \$1,061 an acre, giving a profit of about \$300 an acre. The Cuban tobacco was sold for \$1,200 an acre. During the summer of 1906 the crop grown by the Department from selected seed of both the Cuban and Sumatra varieties was distributed to thirty-three of the largest leaf dealers and cigar manufacturers in the principal cities of the East. These were sent out with a request that they test the leaf and report to the Department their opinion of its quality and its adaptability for manufacturing purposes. Up to the time of closing this report answers have been received from twenty-five of those to whom samples were sent, and with one exception they report that the tobacco has all the qualities demanded by the trade in a domestic cigar wrapper, and if tobacco similar to the samples sent can be grown on a commercial scale they do not hesitate to say that a ready market can be found for it.

There can be no question that tobacco of this quality can be produced on a commercial scale by careful growers if the methods used and recommended by the Bureau of Soils are followed. Notwithstanding the uniformly favorable reports received from the trade on the merits of this tobacco, the Bureau, however, would caution the prospective grower against embarking in the industry on too large a scale at the outset.

#### PREVENTION OF POLE SWEAT.

Owing to the serious damage caused annually in Connecticut by pole sweat or house burn, the Bureau of Soils conducted some preliminary investigations in curing sheds containing both the cut and primed tobacco. A detailed record of the moisture and temperature conditions in each shed was kept, as also of the condition of the tobacco, with a view to determining the point of relative humidity and temperature of atmosphere at which tobacco would begin to pole sweat and the means to prevent the atmosphere of the shed becoming such as to favor its spread. This study will be closely followed, as it is believed that results can be obtained which will be of great value to the Connecticut growers.

Urgent demands have been made upon the Department to extend its operations into Florida, Maryland, Wisconsin, and Tennessee, but owing to the limited appropriation for this work it has so far been impossible to comply with these requests.

#### BUREAU OF ENTOMOLOGY.

Practically all of the investigations under way in the Bureau of Entomology at the time of my last report have been continued with excellent results, and several new and important lines of work have been begun.

##### THE MEXICAN COTTON BOLL WEEVIL.

Encouraging progress has been made in the work against the Mexican cotton boll weevil, as shown by an extensive canvass of the cotton planters who have followed the recommendations of the Bureau.

Owing to climatic conditions in the summer and fall of 1904 and in the winter of 1904-5, some of the area that became infested late in the summer of 1904 was entirely devoid of weevils in the early part of 1905, but the fall movements of the weevil in 1905 more than covered



this area. This permitted studies for which there had been previously little opportunity, and many points which had a bearing upon the possibility of the continued advance of the pest were investigated.

#### EXPERIMENTAL FARMS.

The continuation of the experimental farms at fourteen places in Texas has been deemed desirable, as the value of experimental field work depends largely upon the number of seasons through which it has been carried. Two additional experimental farms have been carried on in Louisiana. The whole acreage placed under contract in these experiments is 877.

The modifications in the cultural system of lessening damage, made necessary by the change in habits of the insect, were carefully studied in connection with the work carried on in the laboratory.

#### OTHER FIELD WORK.

In addition to experimental plats on a large scale numerous field experiments were conducted, including an extensive experiment in the hand picking of infested bolls and considerable other work directed to the solution of questions which can not be tested with the fullest practical effect in the laboratory.

The continued spread of the weevil has been carefully watched, and publications regarding the new territory infested have been issued in cooperation with the Weather Bureau. Careful study has been made of the conditions in western Texas in order to determine whether the weevil is likely to spread to that part of the State in spite of the general idea that such spread will not take place.

#### LABORATORY WORK

In the well-fitted laboratory now located at Dallas, Tex., the effects of different temperatures and the condition of food supply upon the development of the weevil were tested, the breeding of parasites was continued, and a special study was made of a native ant which seems to be becoming more and more an important factor in the natural control of the weevil. Investigations of the distribution of this ant, its adaptability to different soil conditions, and the possibility of its artificial propagation have also been made.

#### TRUE PARASITES OF THE BOLL WEEVIL.

Since the weevil entered Texas native parasites have had little effect upon it until recently. During the year, however, it was found that in the Brownsville region—first entered by the weevil about 1893—native parasites have accommodated themselves to its habits, and now at least 50 per cent of the early stages are sometimes destroyed by these parasites. Consequently much attention is being paid to the parasite question, in order to determine whether it will be possible to assist the work of these beneficial insects. It seems probable that the small results gained from the work of parasites down to the present time are largely due to the recent invasion of the cotton fields of the South by the injurious insect.

#### COOPERATION WITH THE LOUISIANA CROP PEST COMMISSION.

Cooperation with the Louisiana Crop Pest Commission, begun in 1904, was continued during the year, three assistants being employed by the Bureau for work in Louisiana. During the season of 1905 it

was planned to enter upon an extensive study of the so-called migratory movement of the boll weevil in order to learn, if possible, some method of checking its further advances, or at least to learn more definitely the approximate time when other regions may become infested. On account, however, of the occurrence of yellow fever and the consequent rigid quarantine, it was impossible to carry on this work in full, but a number of important observations were made. In cooperation with the commission more than 25,000 weevils were carefully studied under natural conditions during the winter.

#### THE COTTON BOLLWORM.

The work on the cotton bollworm during the fiscal year was largely in the character of demonstrations, indicating the value of conclusions already reached and detailed in the last annual report of the Entomologist, and successful efforts were made locally in the extermination of the bollworm by means of poisons.

#### OTHER COTTON INSECTS.

The work on other cotton insects has been done largely in cooperation with the Texas Agricultural Experiment Station. A field agent of the Bureau was stationed at the Texas Agricultural College, devoting his attention to the other insects affecting the cotton plant. The important discovery has been made that it is possible to propagate the predaceous enemies of the cotton plant-louse, an insect which sometimes causes great damage to young cotton. It is believed that this work will lead to a practical method of controlling the pest.

#### "INTRODUCTION OF BENEFICIAL INSECTS.

The most important work in connection with the introduction of beneficial insects has been the importing from Europe of the parasites and predaceous enemies of the gipsy and brown-tail moths, in cooperation with the officials of the State of Massachusetts.

#### PARASITES OF THE GIPSY MOTH AND BROWN-TAIL MOTH.

It has been shown that it is an easy matter to bring the European parasites of these injurious insects to this country, simply by collecting numbers of the larvæ and chrysalides in different parts of Europe and sending them direct to Boston. A certain percentage of these insects on arrival in New England have given out the European parasites, which have either been cultivated in wire-gauze inclosures, with plenty of food, or have been liberated in the open, there being chosen for this purpose patches of woods not subject to forest fires or to remedial work against the insects. It has been ascertained further—and this is a fact hitherto unknown even to European entomologists—that the young larvæ of the brown-tail moth in their overwintering nests in Europe are extensively parasitized. Therefore, during the winter of 1905-6 over 117,000 nests of the brown-tail moth were collected in 33 different localities in Europe, ranging between North Germany, South Hungary, and West Brittany, and comprising a large range of varying elevations and climatic conditions. More than 70,000 parasites were reared from these nests on American soil. About 8 per cent of these were hyperparasites; that is, parasites upon parasites.

By means of specially constructed cages the hyperparasites were separated and destroyed. The primary parasites were placed in out-of-door cages or liberated in the open. The largest colonies included 10,000, 15,000, and 25,000 parasites, respectively. Owing to the very wet season a fungous disease prevailed among the caterpillars, vitiating to some extent the results of the experiments, but nevertheless three species of parasites were seen to lay their eggs in American-born caterpillars, and there is positive proof of the development on American soil of at least one complete generation of two of the European species. It has been shown that they may breed successfully through the season.

Egg parasites of the brown-tail moth have also been imported during the summer, and have been seen to lay their eggs in the eggs of North American injurious insects. Two important European predatory ground beetles have been successfully imported, and have bred through an entire generation upon American soil. Large numbers of *Tachina* flies have been reared from European specimens of the larvæ of both the gipsy moth and the brown-tail moth, and are breeding in the vicinity of Boston.

The greatest care has been taken to prevent the introduction of hyperparasites and other injurious insects, and there seems every reason to suppose that sooner or later the complete natural environment of both the gipsy moth and the brown-tail moth will be established in New England, placing them on a par with European conditions, thus greatly reducing their present importance.

#### NEW LADYBIRDS FROM EUROPE.

During the late winter months and spring of 1906 several species of European ladybirds, well known as destroyers of plant lice, scale insects, and soft-bodied insects of other groups, have been imported from Germany, France, and Austria. All of these have been liberated in the vicinity of the parasite laboratory at North Saugus, Mass., the country about being orchards and forests, with an occasional vegetable garden, promising plenty of food for the beneficial species.

#### THE KELEP OR GUATEMALAN ANT.

Efforts to successfully overwinter in Texas the kelep or Guatemalan ant enemy of the cotton boll weevil have failed and a possible useful rôle for this insect in Texas is seemingly very slight. It is possible that this species may have some economic value in some of our tropical or subtropical possessions, where the climate will be more suitable than in Texas.

#### THE SENDING OF USEFUL INSECTS ABROAD.

It is possible, in many instances, to secure the sending of beneficial insects by the official entomologists of other countries without expense to the Department, as was done notably in the case of the introduction of an important enemy of the black scale from the government of Cape Colony, South Africa. In return for such services, and as an earnest for possible future courtesy of the same sort, exportations of parasitic and predatory insects have been made, under the auspices of the Bureau of Entomology, to foreign countries. A notable instance has taken place during the fiscal year. A scale insect which occurs



abundantly upon various fruit trees in portions of the United States is a serious enemy to the mulberry tree in Italy, and therefore large sendings of parasitized scales of this species have been shipped to Professor Berlese, Director of the Royal Station for Agriculture and Entomology, at Florence. After arrival two species of parasites were bred in some numbers, and efforts are now being made to colonize them in Lombardy. It is hoped that they will prove effective aids in the eradication of the mulberry scale.

#### INSECTS DAMAGING FORESTS.

Investigations of insects damaging forests have progressed in a satisfactory manner in cooperation with the Forest Service of the Department. Numerous problems have been studied and a large store of general information upon forest insects has been accumulated.

Field work has been conducted from stations in West Virginia, North Carolina, South Dakota, Idaho, Washington, and California, the locations of the stations being determined by the advantages offered at the points selected for the study of some special problem or problems.

A special investigation was carried on in regard to the Black Hills beetle, which has extensively ravaged the forests in Colorado, and the results prove to be in the highest degree satisfactory and have been published in Bulletin 56 of the Bureau. The recommendations are now being actively followed by private persons with excellent chances of checking what might otherwise prove a most serious invasion.

The conditions in the Black Hills are not so encouraging, owing, doubtless, to the failure of the parties interested to realize the importance of the recommendations of the Bureau. These difficulties, however, have now been partially overcome, and all concerned seem alive to the seriousness of the situation.

Investigations in the South of the destructive pine-bark beetle and of a number of important insects injurious to forest products have been carried on, and studies have been made in regard to the insect enemies of forest reproduction. Special studies and recommendations have been made concerning the western pine-bark beetle in the region north of Boise, Idaho, and a study of the forest insects of the Pacific slope has been carried on.

#### INSECTS DAMAGING DECIDUOUS FRUIT TREES.

For the investigation of insect enemies of deciduous fruit trees field stations at Youngstown, N. Y., and Fort Valley, Ga., were carried on to the close of the growing season of 1905, and in the spring of 1906 others were started at Myrtle, Ga., and North East, Pa. Later another one was established at Nebraska City, Nebr. In the course of this work some studies have been made of the parasites of the San Jose scale, and experiments have been made with a number of insecticide mixtures. The chemical study of the lime-sulphur and other washes has been undertaken in cooperation with the Bureau of Chemistry. New studies have been made of the plum curculio. The peach borer has also been studied throughout its geographic range, and extensive demonstration work has been done in Nebraska on remedies for the codling moth, in cooperation with the Bureau of Plant Industry, which at the same time was dealing with the apple scab, combination



treatments for both being carried on cooperatively. Cooperation in this work is also under way with the several other experiment stations and the Georgia State entomologist.

#### FIELD-CROP INSECTS.

The most important work in connection with field-crop insects has been upon the Hessian fly and jointworms, especial investigations having been made of the Hessian fly in the spring-wheat regions. It was predicted that this insect would not damage wheat in regions where the spring crop is exclusively grown. This has proved to be a fallacy, and by reason of remarkable changes in the life history of the insect it has adapted itself to the conditions existing in the far north-western country. This means a radical modification in remedial work, and the studies have indicated that it will not be difficult to bring about conditions of comparatively small insect damage. Important results have also been reached in the study of parasites of the Hessian fly, which will probably have a marked effect upon the multiplication of the fly. In the same way the jointworm investigations have resulted in the acquisition of important knowledge, both regarding possible remedial work and the handling of parasites. Studies have also been made of clover seed and clover insects, and also of other field-crop pests.

#### INSECTS AFFECTING VEGETABLE CROPS AND STORED PRODUCTS.

Work on insects affecting vegetable crops and stored products has been continued along the same lines as conducted in previous years. Insects affecting the sugar beet have been studied with care, and a special investigation has been made of a leaf hopper affecting this crop in Utah, Idaho, and Colorado. Many other insects of this group have been under careful observation, and results of value have been obtained.

#### INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

The work of the Bureau on the subject of mosquitoes has been continued. A further study of the yellow-fever mosquito was made in the autumn of 1905, and experiments were made with remedies and methods of destruction against both larvæ and adults. Records have been brought together of the life histories and geographic distribution of the majority of the mosquitoes inhabiting North and Central America and the West Indies.

In the spring of 1906 a publication was issued upon the subject of the house fly, calling attention to its agency in the spread of typhoid fever, pointing out proper methods for its control, and urging the adoption of these methods by individuals and communities.

It was shown by observations made by the Bureau of Entomology upon a series of stables in two different sections of the city of Washington that it is a comparatively easy matter greatly to reduce the numbers of the house fly in any given community at a comparatively slight expenditure of funds and effort.

The investigation of the life history of the Texas cattle tick, mentioned in the last annual report, has been continued in cooperation with the entomologists of the States of Louisiana, Arkansas, Alabama,

Tennessee, and South Carolina. This work has considerably increased our knowledge of the development of the tick, and in connection with this work the life history and habits of a number of other common ticks, frequently confused with the fever-transmitting species, have been investigated.

#### SCALE INSECTS AND EXPERIMENTAL WORK WITH INSECTICIDES.

This work, in special charge of the Assistant Chief of the Bureau of Entomology, has been continued. An immense amount of material in this group is sent in to the Bureau for identification and advice and the work grows in importance and value.

A thorough inspection was made of all new plants which the Department of Agriculture is importing from different parts of the world to detect and destroy any new insect enemies, principally scale insects, which might be brought in with them.

The work with insecticides has covered tests with standard insecticides, fumigation of mills, granaries, and dwellings against insect pests, and many new insecticide ideas or mixtures, which come to the Bureau for attention almost daily, have been examined and reported on.

Tests carried on upon a large scale and in a very thorough manner with sulphurous-acid gas have fully demonstrated its usefulness.

#### BEE CULTURE.

The work on bee culture has greatly increased. A large number of queen bees of different varieties were reared and distributed from the Department apiary, as well as from the substation at Chico, Cal. Investigations of the giant bees of India and the Philippines were continued through the year.

The various methods of queen rearing have been tested in rearing queens for distribution, and studies in bee diseases and in the important subject of honey-producing plants have been carried on.

#### SILK CULTURE.

There has been no change in the method and scope of the work on silk culture during the year. The correspondence was increased; a supply of eggs has been brought from Europe and distributed to correspondents in the United States; mulberry stock has been distributed, and cocoons have been purchased from correspondents and reeled.

#### OTHER INVESTIGATIONS.

Work on insects injurious to strawberry, raspberry, blackberry, and other bush fruits has been continued, and studies have been made of insects injurious to flower gardens and in greenhouses. An especial study of the insect enemies of roses is under way. The study of insects affecting shade and ornamental trees has also been continued, and an investigation has been made into the habits of the gad flies.

Routine work in the laboratory has greatly increased and biological studies have been made of nearly 500 species not hitherto studied. Increase has also been noted in the work of determining specimens for the entomologists of experiment stations and other workers. Many thousands of specimens have been received for this purpose.

**BUREAU OF BIOLOGICAL SURVEY.****GEOGRAPHIC DISTRIBUTION.****LIFE AND CROP ZONES.**

The Biological Survey deals with many of the problems of the farm, orchard, and stock range, and aims to answer in a practical way many of the questions that arise in their management. One of the most important of these is the selection of crops and breeds of stock adapted to the local peculiarities of temperature, moisture, and other climatic factors that prevail, not only in different areas, but which in mountainous regions often characterize different parts of the same farm. A direct and reliable guide to such selection, apart from costly experimentation is afforded by the distribution of the native plants and animals, for it has been learned that animals and plants are not scattered haphazard over the land, but in their distribution are governed by fixed laws. Thus the association, on a given area of certain birds, mammals, trees, and shrubs, presupposes the existence there of certain climatic and physical conditions.

It naturally follows that there is a direct relation between the plant and animal life of such an area and the nature of the crops that can be grown upon it. The purpose of a biological survey of the several States is to supply life-zone maps based upon a study of the natural animal and plant life, followed by crop-zone maps with lists of fruits and crops which will best thrive in such areas. A generalized report of this nature, covering the United States as a whole, has been already published (Bull. 10, Biological Survey). The work is now being carried on in more detail and on larger scale maps in several of the Western States.

**DISTRIBUTION AND MIGRATION OF DUCKS AND SHORE BIRDS.**

As the game birds of the country diminish in numbers, and as their importance in the eyes of sportsmen and for food increases, the necessity of legislative protection becomes more imperative.

In order to afford an accurate basis for such legislation, the routes of migration and the time of arrival and departure of ducks and geese and the shore birds have been carefully studied.

**ECONOMIC INVESTIGATIONS.****ECONOMIC MAMMALOLOGY.**

The field included in this branch of the work is wide and important, the losses inflicted upon the agricultural and stock-raising interests in the United States by noxious animals amounting annually to many millions of dollars. The most prominent offenders are the wolves and the gnawing animals known as rodents—especially the rats and mice, rabbits, ground squirrels, and gophers. Much time and ingenuity and vast sums of money have been expended in devising means to restrict the numbers and minimize the damage done by these animals. Traps, poisons, and gases have been carefully experimented with under varying circumstances, and have proved more or less effective, but the farmer does not always possess the requisite time and skill to employ them to best advantage, and even when they serve to accomplish the object intended the cost is considerable.

Meanwhile agriculture is assuming more and more importance in the United States, and with increasing crops comes a corresponding increase in the numbers of the pests that destroy them.



In the hope of finding a remedy, the Bureau of Biological Survey is now engaged in experiments with epidemic diseases—diseases which in the course of nature break out at intervals and serve to reduce the numbers of rabbits, squirrels, mice, and other noxious animals to below the danger point. As some, if not all these diseases, are of bacterial origin, it is thought possible to obtain and preserve cultures of them for employment when and where occasion arises. Prior to their use in the field, however, a series of careful experiments is necessary to determine the character of the diseases—whether limited, as some undoubtedly are, to particular animals—the degree of their virulence, the extent of their communicability from animal to animal of a colony, and above all to make sure that human beings and farm stock are immune from their influence.

In cooperation with the Bureau of Animal Industry, experiments have been already made with a virus for destroying rats and mice, and in cooperation with the State Agricultural Experiment Station at Pullman, Wash., experiments are being tried with a disease endemic to one of the ground squirrels of that region. The results of the latter experiments are awaited with peculiar interest, since the area infested by ground squirrels in Washington, Oregon, and Idaho is very large, and everywhere over it great damage is done to the wheat crop.

With a view to eliciting timely information as to the prevalence of epidemic disease among rabbits, ground squirrels, prairie dogs, rats, and mice, a circular of inquiry has been widely distributed. The subject is one of large possibilities, and time and money will be well spent if effective and economical methods are found to relieve the farmer of part of the burden and expense of protecting his crops from rodent pests, which are as numerous and destructive as they are ubiquitous and elusive.

#### DEPREDACTIONS BY WOLVES.

In cooperation with the Forest Service investigations are being made with a view to the reduction of the numbers of wolves on the stock ranges and on the game and forest reserves of the West. Wolves are still numerous in certain sections, and by reason of their size and strength constitute a formidable enemy to stock and to wild game. It is thought that effective means for the abatement of the nuisance have been found and a report on the subject will soon be ready for publication.

#### THE RABBIT PEST.

The damage to nurseries, orchards, and crops of the United States by rabbits has always been great, though happily nowhere reaching the proportions reported in Australia. Many experiments have been made by assistants of the Survey for the purpose of discovering cheap methods of protecting orchards by wire fencing and by other means, and of reducing the number of rabbits by traps and poisons. It is believed that young trees in orchards and in forest reserves, where they are particularly liable to destruction by rabbits, can be cheaply and efficiently protected by cylinders of woven wire, and experiments are being undertaken in cooperation with the Forest Service for testing the efficiency of such protectors. Rabbits in various parts of the country appear to be peculiarly susceptible to epidemic diseases, and as they are one of our most destructive rodents special efforts are being made to detect the presence of one of these epidemics for the purpose of securing cultures as a means of reducing their numbers.



## THE BOLL WEEVIL.

During the year investigations were continued in the Texas cotton districts with reference to birds that feed upon the weevil. The results are encouraging. In all, 28 species of birds have been found to be more or less active enemies of the insect. Included in this number is the nighthawk, heretofore not known to eat the weevil. The nighthawk proves to be an active consumer of the insect. Its protection by law therefore is earnestly recommended. This is all the more necessary, since the bird is often shot for food.

Of all the birds that prey upon the weevil, orioles are the most active and persistent. For this reason the possible introduction into the Gulf States of one or more additional species of these birds is being considered. Only one of the three species that visit the cotton-producing belt breeds extensively within it; hence if one is introduced it should be a species likely to make its summer home within the area infested by the weevil, as all birds are particularly assiduous in their search for insects during the time they are feeding the young.

## CALIFORNIA FRUIT ORCHARDS.

Work in the California fruit orchards is being continued and a study made of the food habits of birds destructive to orchard fruit, with a view to the suggestion of preventive measures.

Careful investigations are being conducted also into the food habits of all birds that live in and around orchards, so that the orchardist may be clearly informed as to the beneficial species, in order that he may be able to discriminate between friends and foes.

## SCALE INSECTS.

Few kinds of insects are so inimical to the health and existence of fruit trees and other crop plants as the scales, and owing to their small size and peculiar habits few are so difficult to cope with. It has been generally supposed that birds lend no assistance in the destruction of scales. This proves to be an error, for the Biological Survey has already found that more than 50 species of birds eat scale insects. Not only is this true, but in the case of certain species, as the grosbeaks, scales have been ascertained to form a large percentage of the food.

## GAME PROTECTION AND INTRODUCTION.

The experience of many countries proves how widespread is the desire to introduce foreign mammals and birds. When these are merely for cage pets or for exhibition in zoological collections, little or no harm results. But when, as frequently happens, exotic species are liberated in the hope that they will become acclimated and form permanent additions to the fauna, there is always danger that, like the English sparrow, they will be only too successful in adapting themselves to the new environment and prove serious pests. The disastrous experiments of Jamaica, Porto Rico, Hawaii, New Zealand, Australia, and other regions abundantly illustrate this danger. Several countries take the precaution of regulating such importations, the United States among the number. Since 1900 the Department of Agriculture has supervised all importations of live birds and mammals into the United States. A few well-known species of birds and mammals are allowed to enter without special authorization, but all others are refused entry except under permit by the Department. The number thus entered during the year was 654 mammals, 274,914 canaries, and 47,256 miscellaneous birds.

The growth of the trade in imported birds is made manifest by the fact that the figures show an increase of 25 per cent over those for last year, and of 33, 27, and 37 per cent, respectively, over those for 1903-4, 1902-3, and 1901-2. Despite the large number of birds and mammals imported under permit, averaging more than 6,000 a week throughout the past year, it is believed that no prohibited species was brought into the country.

Increased interest is shown in the importation of foreign game birds for stocking covers. During the year 864 European partridges, 116 capercaillie, 73 black game, and 59 other game birds were imported for this purpose. Some of these experiments promise excellent results.

Stocking covers with birds hatched from imported eggs has heretofore been unsuccessful in most cases. Last spring, however, of 5,564 eggs imported under permit by the Department, 5,500 were English pheasant eggs secured by the game commissioner of Illinois, who reports that 3,000 live, healthy chicks were obtained—an unusually large percentage.

Large shipments of birds are examined by inspectors and the number and kinds are reported to the Department. The expense of fees has hitherto been borne by importers, since no appropriation for the purpose was made by Congress. This arrangement proved unsatisfactory and protest was made by importers. Since February 1, 1906, the Department has undertaken to pay these fees, and an appropriation should be made to sustain the service, as in the case of inspection of meats. The lack of such appropriation permits inspection only of the most important shipments.

#### INTERSTATE COMMERCE IN GAME.

The close surveillance of interstate traffic in game established in the Middle West has driven illegal shippers to the use of freight instead of express, and has brought the situation in that region under partial control. Attention will therefore be centered during the coming year on the Southwest, where systematic violations of the law are frequent. An effort will be made also to check numerous illegal shipments that occur in the South, particularly in West Virginia, Virginia, and North Carolina.

The limited means available for this work make progress slow and difficult. A sufficient sum should be appropriated to permit the employment of three supervisors, at Chicago, St. Louis, and Baltimore, respectively, to study conditions, secure evidence of illegalities, assist prosecuting officers, and aid generally in a more effective enforcement of the law.

#### BIRD RESERVATIONS.

One of the most successful methods of preserving the birds of a country is by setting aside regions that contain important colonies of breeding birds as bird reservations or "refuges." England, Australia, Canada, New Zealand, and other countries have followed this plan with great success, and in 1903 the United States inaugurated it by making a bird reservation of Pelican Island, Florida, to preserve the only colony of brown pelicans on the east coast of Florida. Afterwards two more reservations were established—Breton Island, Louisiana, and Stump Lake, North Dakota—and in the year just ended four more were added to the list, two in Florida, consisting of

Passage and Indian keys, at the mouth of Tampa Bay, and two in Michigan, comprising the Huron Islands and the Siskiwit Islands in Lake Huron.

These reservations contain large colonies of water birds—ducks, gulls, terns, pelicans, etc.—and their establishment will serve to preserve certain native species from possible extermination and provide favorable places for the study of bird life. It has been found essential to have Federal authority to punish trespassers instead of depending on varying State laws, and accordingly, at the suggestion of this Department, Congress passed an act (approved June 29, 1906) providing a penalty for trespass on bird and game reservations. This law will enable the wardens on bird reservations to protect them from marauders.

#### BIG GAME REFUGES.

It is gratifying to state that part of the herd of dwarf elk presented to the Government by Miller and Lux was successfully transferred to the Sequoia National Park in November, 1905, thus insuring the preservation of this rare species.

It is now possible, also, to transfer to an ideal buffalo range in the Wichita game preserve the herd of buffalo offered to the Department by the New York Zoological Society, as Congress at its recent session appropriated \$15,000 for the construction of the fence necessary for a proper inclosure.

The plan of preserving big game from extermination by providing game refuges where shooting is either prohibited or carefully regulated is at present attracting attention all over the world. In order to profit by the experience of other countries in a matter that must soon be of pressing interest in the United States, investigation has been made of the systems employed in Canada, particularly Ontario and Quebec, the Transvaal, Natal, British East Africa, Sudan, and Cape Colony. This work has been carried on by correspondence and will be continued and extended during the coming year.

#### GAME PROTECTION IN ALASKA.

The preservation of the game of Alaska continues to present difficult problems. With the present unsatisfactory game law, and no appropriation available for enforcing its provisions, the efforts of the Department have been confined to preventing export of heads and skins by trophy hunters and dealers in hides, a fruitful source of destruction.

#### INFORMATION CONCERNING GAME.

In performance of the important duty of collecting and disseminating information relating to game, the annual summary of game laws, posters of close seasons, and directory of officers and organizations concerned in the protection of game have been published as usual, and also various pamphlets relating to special features of game protection. In the near future it is intended to secure and publish information concerning hunting-license statistics, game refuges and preserves, introduction and propagation of game birds, duties of the modern game warden, and the cage-bird traffic of the United States.

The constant demand for information on these and kindred matters shows how important is this phase of the work. It is impossible to meet this demand satisfactorily with the present limited force and available means, and an increase in both is much needed.



### DIVISION OF PUBLICATIONS.

The work of the Division of Publications continues inevitably to increase with the growth of the Department. The number of publications issued in 1904 was 972; in 1905, 1,072; and in 1906, 1,171. The number of copies issued in 1906 aggregated 13,488,021. The larger proportion of these publications consisted of reprints, but the new publications in 1906, exclusive of those of the Weather Bureau, numbered 414.

#### FARMERS' BULLETINS.

The total number of issues of Farmers' Bulletins during the fiscal year was 437, of which 404 were reprints, and the total number of copies was 6,568,000.

The demand for Farmers' Bulletins by Senators and Representatives, who under the law are entitled to 80 per cent of the whole number printed, has been so much larger than usual that practically none were left to carry over to the present fiscal year. There being therefore no surplus available and the appropriation for the current fiscal year being no larger than formerly, the number available for each Congressman will this year be greatly reduced. I have therefore felt obliged to include provision for an increase in the number of these bulletins in my estimates for the ensuing year. The number of copies of Farmers' Bulletins distributed during the past year on Congressional orders aggregated 5,279,476.

#### ADVISORY COMMITTEE.

On January 23, 1906, in accordance with your Executive order of the 20th of that month, I appointed an advisory committee on the subject of printing and publication, as follows: The Assistant Secretary, chairman; the Chief of the Weather Bureau, and the Department Editor, secretary. The rules laid down for the guidance of the committee in the Executive order referred to, conform so closely to the regulations governing the printing and binding of this Department imposed upon the Division of Publications, of which the Department Editor is the chief, that it was not found necessary by the committee to adopt a different system of work or to recommend many changes in the existing orders. The services of the committee were, however, extremely helpful in disposing of many questions submitted to it by the Department Editor, which would otherwise have called for my personal intervention. Up to date the committee has held ten meetings, not at stated times, but at the call of the chairman whenever questions of importance were ready to be submitted to it.

#### CONGRESSIONAL PUBLICATIONS.

Several important amendments to the law governing the public printing and binding have resulted from the special investigation conducted by the Joint Committee on Printing of the Senate and House. One of these provides that the first cost of all publications known as Congressional publications shall be charged to the printing fund of the Department itself instead of to the appropriation for the printing and binding for Congress, together with the cost of the copies assigned to the Secretary for Departmental use. This has made it necessary, of course, to secure an increase in the appropriation for printing for the use of this Department, and the additional amount estimated, as



above made necessary, has been duly appropriated by Congress. This, in reality, is not an increase, but a transfer from one fund to another.

Another amendment provides that public documents ordered printed for Congress may be printed in two or more editions not exceeding in the aggregate the total number authorized by law. This provision applies not only to the number assigned to the use of Congress, but also to the number assigned to the use of the Department. This amendment will doubtless tend greatly to prevent waste by over-publication.

#### LIMITATION OF APPROPRIATION FOR PRINTING.

A further amendment to the law provides that estimates for the printing and binding of each Department shall be included in a single item, and that after the expiration of the current fiscal year no appropriations other than those made specifically and solely for the printing and binding shall be used for such purposes. In this connection, I desire to place myself on record as strongly favoring the inclusion of the appropriation for printing and binding in the regular appropriation bill for the support of this Department, instead of being, as now, included in a separate appropriation in the sundry civil bill for the general printing and binding of the Government.

#### INCREASING DEMAND FOR PUBLICATIONS.

The demands for publications continue to increase more rapidly than does the ability of the Department to meet them. The policy followed in the past of continuing the distribution after supplying the regular divisional lists, including libraries, agricultural colleges, and stations, exchanges—foreign and domestic—and persons actively cooperating in the work of the Department, to all miscellaneous applicants until the edition was exhausted, and then ordering a reprint to satisfy further demands, while perhaps the best method to be pursued in any plan of unlimited gratuitous distribution, was found very unsatisfactory.

In the first place, the funds at our disposal precluded the possibility of unlimited reprints, and thus, while a great many persons were supplied who undoubtedly did not need the publications they asked for, a large number of persons to whom the publications would prove useful were unavoidably left unsupplied, including very often persons whose services to the Department gave them a special claim on us for our publications. Such a plan might have been satisfactory enough in the days when the demand for the Department's publications was not so great, though even then it was wasteful; but at the present time to undertake to supply all miscellaneous applicants—and this is the only fair way if the principle of gratuitous distribution is to obtain—would involve a cost far exceeding any sum which Congress is likely to provide. In the face of the difficulty thus presented to me for solution, I concluded to abandon any attempt at general gratuitous distribution of all Department publications other than Farmers' Bulletins and circulars.

#### FIRST EDITIONS.

On April 14, 1906, I issued a general order which limited the first edition of every publication to the number of copies necessary to supply libraries, educational institutions, the press, State and foreign

officials connected with agriculture, exchanges, and such persons as render tangible service to the Department, either by actively cooperating in its work or as special correspondents, and including a small number to be reserved for emergencies and for use in correspondence, and to furnish a small supply to be placed in the hands of the Superintendent of Documents for sale. I am indebted to the courtesy of this official for the subjoined statement, showing the total number of the publications of this Department sold by him during the last fiscal year and the sums received therefor, and, for purposes of comparison, the total number sold of all Government publications and the amount received:

Publications of Department of Agriculture.....	copies..	47,745
Amount received therefor.....		\$5,388.28
All Government publications.....	copies..	75,828
Amount received therefor.....		\$16,495.88

#### REPRINTS BY THE SUPERINTENDENT OF DOCUMENTS.

I am also indebted to the Superintendent of Documents for a report showing that under the provisions of joint resolution No. 11, approved March 28, 1904, and with the concurrence of this office, as therein provided, 43 reprints of Department publications were ordered by him from the Public Printer during the year ending June 30, 1906, in editions of from 100 to 1,500 copies, in order to satisfy the requests of purchasers. Under the terms of the resolution referred to, these reprints, which aggregated over 10,000 copies, were paid for from the funds received by the Superintendent of Documents from the sale of our publications. This sale of Government publications under the provisions of the resolution, which authorize him to reprint as occasion requires, defraying the cost of same from the sums received by him as purchase money, affords the most equitable plan for the distribution of these publications to miscellaneous applicants. It involves no waste, meets the requirements of all parties interested at a minimum cost to the Government, and provides for a supply adequate to any possible demand.

To make this system a complete success requires the extensive advertising of the existence of these publications, and to this end this Department supplies each month to all persons desiring it a list of the publications issued during the month previous. By this means, and through the intelligent courtesy of the press, our publications are widely advertised. A second requirement is, in my opinion, that these publications should be sold at cost of paper, printing, and binding, the cost of the first edition, which includes the making of the plates, being properly defrayed by the Government. Another great convenience would be afforded to intending purchasers if the Superintendent of Documents were authorized to receive postage stamps as cash. This is especially true where the sums involved amount to or include fractions of a dollar.

#### DEMAND FOR PUBLICATIONS BY EDUCATIONAL INSTITUTIONS.

A great many demands are being made upon us by educational institutions for publications of this Department to be used as text-books, and as these demands usually involve supplying whole classes of students with the same publication, the question promises to present some difficulties. Heretofore I have made it a point to grant such requests, but how long I can continue to do so gratuitously, in the face of

rapidly increasing demands of this character, is problematical. In many cases, especially where there has been cooperation between State institutions and this Department, the number desired is so great that the parties themselves desire the privilege of purchasing hundreds, and sometimes thousands, of copies.

Under the law regulating such matters the Public Printer is authorized to sell not more than 250 copies to any individual, and the applicant must file his order before the publication goes to press. In the cases I refer to, this number is generally inadequate, and moreover it is impossible to comply with the condition. There is then left to the institution or official desiring the publications the alternative of purchasing the plates, with a view naturally to saving the cost of composition. Under the law no saving can be effected in this way. The Public Printer is compelled to charge not only the cost of the metal in making the plates, but also the original cost of composition. I would suggest an amendment to the law, authorizing the Public Printer to supply duplicate plates of Government publications at the cost of such duplication, with 10 per cent added for handling, to all applicants duly indorsed by the head of the Department issuing the publication.

### BUREAU OF STATISTICS.

#### SUMMARY OF THE WORK DURING THE YEAR.

The work of the Bureau of Statistics is performed in three divisions: (1) The Division of Domestic Crop Reports. (2) the Division of Foreign Markets. (3) the Miscellaneous Division.

As in former years, the principal work of the Bureau of Statistics has been the collection and dissemination of information regarding the acreage, condition, and yield of the principal agricultural crops of the United States.

The Division of Domestic Crop Reports handles the great mass of reports received from month to month by the Bureau for the use of the Statistician and the Crop Reporting Board in preparing the estimates of the Bureau.

The work accomplished in this Division is supplemented by reports received from salaried State statistical agents, one of whom is located in each State, and from special field agents who travel within and throughout defined territory, consisting of two or more States, examining the crops in the field and securing information for the use of the Bureau from all available sources, such as country bankers, agricultural implement dealers, representative farmers, country merchants, and others.

During the year the scope of this work has been very greatly broadened, the increase being approximately 100 per cent. Twenty-five crops not previously dealt with by the Bureau have been added, concerning which reports of condition are made from month to month. This has taxed the working capacity of the clerical force of the Bureau, and has rendered it necessary that they be required to do considerable work above and beyond the regular hours of service ordinarily required.

The special field service of the Bureau of Statistics, as well as the corps of State statistical agents, has been considerably strengthened and the work of these employees has been placed upon a uniform, scientific basis, such as did not formerly prevail. The reports of the Bureau and the methods employed in making them seem to have met with general approval, and have largely increased the confidence of



producers, consumers, dealers, and the public generally in their integrity and accuracy.

In order to prevent the possibility of information regarding the reports of the Bureau being prematurely given out, methods have been adopted which render such leakages impossible. These are explained and described in detail in the annual report of the Statistician of the Bureau. The value of the monthly crop reports of this Bureau has been so thoroughly established that any suggestion looking to their curtailment meets with vigorous objection and opposition from all who are interested in the promulgation of fair, unbiased estimates regarding acreages, conditions, and yields of the products of agriculture.

The Division of Foreign Markets compiles information regarding the imports and exports of all the different classes of farm products; also of manufactured products as far as the output of packing houses can be so denominated. The information thus gathered is published annually in bulletins, to which wide circulation is given. In addition to this regular work, studies are made of conditions in countries competing with the United States in the world's markets, with regard to packing-house products and meat animals, and a large amount of instructive matter has been collected and published.

Investigations have also been conducted by this Division of the world's meat trade; of the comparative healthfulness of meat animals in different countries; of the situation throughout the world with regard to cotton production; of the British market for dairy products and its sources of supply; wheat growing in Russia; freight rates, and the world's production and trade in barley, rye, potatoes, wheat, tobacco, cotton, and other agricultural products.

During the past year a very interesting study was consummated upon the subject of the increase in farm values in the United States, the results of which have been published in bulletins which have attracted wide attention and interest.

In the Miscellaneous Division of the Bureau of Statistics, which embraces the statistical library, the necessary translations incident to the work are made; and a few clerks are engaged in special work, such as the compiling and preparing of material to be used in answering inquiries for agricultural statistics made by Members of Congress and others. The services of the clerks in this Division are called into requisition in the tabulation and computation of the monthly crop reports, or for any other purpose for which they may be required.

(An employee of the Bureau of Statistics is stationed in London and from that point makes trips to the different European countries, collecting information regarding crop acreages, conditions, and yields, which he sends to Washington each month for publication in the *Crop Reporter*, a monthly publication of the Bureau, in which are given the reports of the Bureau, placed in comparison with reports for previous years at the corresponding dates, together with various other statistical information of interest to farmers and dealers in and consumers of farm products.)

Much statistical work in the way of tabulation and computation has been done for other Bureaus of the Department, and though the regular work has been greatly increased through the enlargement of its scope, all the statistical service required by other Bureaus has been accomplished promptly and satisfactorily. The work of the Department is being unified and made cooperative in many lines of research and demonstration.



Investigations have been carried on through a series of years regarding the cost of producing farm products, and results of these investigations have been embodied in bulletins, which, it is believed, will be of great value and interest.

### THE LIBRARY.

The growth of the Library has exceeded that of any previous year, so that at present the scientists of the Department have available for their use a collection of scientific books, periodicals, and pamphlets numbering over 92,000. All new publications of value relating to general agriculture and to special subjects concerning which investigations are being carried on by the Department have been purchased, over 500 periodicals alone being received regularly. This Library is gradually growing to be the most complete collection of agricultural literature in the country. Many valuable purchases and gifts have been included in the 5,000 additions of the past year. For the advancement of work in connection with food and drug regulations, meat inspection, and game protection an unusual amount has been expended for law books and other works published in this country and abroad relative to these subjects. Every new line of work entered upon by the Department makes a correspondingly new demand upon the Library.

### CATALOGUING.

The card catalogue of 160,000 author and subject entries is the most valuable key to the resources of the Library. The cataloguing has been kept up to date, so that the material on a given subject is readily available. Cooperation with the Library of Congress and with other institutions which print cards has enabled the Library to secure a larger number of printed cards for its catalogue than ever before. These cards are not only for books and pamphlets of its own, but many show what may be found on subjects of interest to this Department in other departmental libraries. By this means the scope of the catalogue is largely increased at the least cost of time and money.

The cataloguing of the publications of the Department has progressed from year to year until now there is a card catalogue to these documents up to the latest bulletin issued. These cards are valued by all libraries receiving our publications regularly, affording as they do the only up-to-date means of reference to all authors and subjects of the publications. On account of the increasing demands for this catalogue and of the lack of space in the library for handling and storing the cards, it has been found advisable to transfer the printing and distribution of cards to the Library of Congress. This cooperation has given satisfactory results in the advancement of the work.

Not only is the Library indispensable in connection with the work of the Department, but much work has been done in it by visiting specialists, and to many agricultural colleges and experiment stations temporary loans of publications not elsewhere to be found in the country have been made.

### OFFICE OF EXPERIMENT STATIONS.

#### RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The great value of the agricultural experiment stations as agencies for the advancement of agriculture through scientific research was recognized by Congress in a signal manner during the past year by

the passage of the Adams Act. This measure, introduced and championed by the late Hon. Henry Cullen Adams, of Wisconsin, had the unanimous approval of the committees on agriculture in both Houses, passed in Congress without a dissenting vote, and received the approval of the President March 16, 1906. It provides that each State and Territory shall annually receive from the National Treasury a grant of money in addition to that given for the establishment and maintenance of agricultural experiment stations by the act of March 2, 1887 (Hatch Act). The initial appropriation to each State under the Adams Act is \$5,000 for the fiscal year 1906. To this amount \$2,000 is to be added each year for five years, after which an appropriation of \$15,000 is to continue annually. Thus in 1911 and each year thereafter each State will receive \$30,000, double the amount hitherto granted under the Hatch Act. The new act recognizes the fact that through previous National and State legislation the stations are thoroughly organized, are equipped with lands and buildings, and have funds for the printing and distribution of publications.

The extension and strengthening of the experimental work of the stations is therefore made the sole object of the Adams Act, and the additional funds are "to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States." The Adams fund is thus essentially a research fund, and if properly used should produce results of the greatest and most permanent value to American agriculture. The State experiment stations have already performed service of great value. They have done much to secure radical and widespread improvements in agricultural practice; they have contributed in large measure to the creation of a new American literature of agriculture and made it available to every farmer; they have collected much of the material from which a science of agriculture is being formulated as the basis for the instruction of successive generations of farmers in colleges, schools, and farmers' institutes. As their work has developed, it has naturally divided itself into several broad classes, which may be briefly summarized as (1) original research; (2) verification and demonstration experiments, often of a local character and import; (3) inspection service; and (4) dissemination of information. So great has been the local pressure for work of the last three classes that by far the greatest share of the National and State funds has been spent in these lines. The Adams fund now comes in to enable the stations to broaden and deepen their original researches, on the results of which largely depends the success of their other work.

Previous to the passage of the Adams Act the funds of the stations from sources within the States had steadily increased, until in 1905 they exceeded the revenue derived from the National Treasury. There is every reason to believe that the States and local communities will continue to deal liberally with the stations, and that thus they will be able to extend their more popular and directly practical work. The United States will thus have a much more thorough and comprehensive system of agricultural experiment stations.

Congress having put in my hands the administration of the Adams Act, I have assigned to the Office of Experiment Stations the duty of dealing with the experiment stations in matters relating to this act.

The untimely death of Mr. Adams has taken away one of the foremost leaders in the cause of agricultural progress in this country. His clear insight into agricultural problems and needs, his thorough

sympathy with farmers, his appreciation of the benefits accruing to agriculture from the work of properly trained scientists, his independence of thought and action, his fearless advocacy of measures which he deemed of importance to agriculture, his experience in public life both as an administrator and as a legislator, his thorough honesty, which won the respect and confidence even of those who opposed him, put him in a position to render the highest and best service in National councils and legislation. In consideration of the important social and economic changes which our rural communities are passing through in these days, as well as of the vast material interests involved in our agriculture, the loss of such a leader is most keenly felt. Great, however, was his achievement in the short period in which he was a member of Congress, for the name of Representative Adams, of Wisconsin, will ever be linked with that of Senator Morrill, of Vermont, and Representative Hatch, of Missouri, as the author of a measure of fundamental and permanent importance to the institutions which advance and disseminate the knowledge on which our agricultural progress and permanent prosperity largely depend.

#### THE AGRICULTURAL COLLEGES AND SCHOOLS.

In response to demands from numerous sources the work of the Department relating to agricultural education has been gradually broadened, until now it touches nearly every phase of the subject. This Department, through the Office of Experiment Stations, has been active in aiding the establishment of agricultural high schools and the introduction of agricultural subjects into the curricula of the public schools. Representatives of that Office have addressed important educational and agricultural meetings in the interests of agricultural education in a number of States, have given advice regarding legislation and courses of study, and have assisted in the inauguration of agricultural instruction and the securing of agricultural teachers in different localities. The agricultural colleges have been visited and conferences have been held with their officers and teachers. A special study has been made of the agricultural work in the colleges for negroes.

The general interests of higher education in agriculture have been promoted through cooperation with the Association of American Agricultural Colleges and Experiment Stations. As chairman of the standing committee on agricultural instruction, the Director of that Office has aided in studies with reference to the improvement of courses of instruction in the agricultural colleges and schools. He has also acted as dean of the Graduate School of Agriculture, which held a second successful session at the University of Illinois the past summer. The faculty of this school consisted of 35 of our leading agricultural teachers and experts from this Department and the agricultural colleges and experiment stations. The students, drawn from 34 States and Territories, were mainly the younger men already engaged in agricultural teaching and experimenting.

With the development of the Department's work along educational lines it has become clear that it may accomplish important and valuable service as a central agency for the promotion of agricultural education in cooperation with the State departments of agriculture and education, the agricultural colleges and experiment stations, and the State and National agricultural organizations. The most important



lines of educational effort in which the Department should engage may be briefly outlined as follows:

(1) To aid the agricultural colleges to reduce the results of the investigations made by this Department and the experiment stations to pedagogical form for use in agricultural colleges and schools of different grades. This work is now proceeding too slowly to keep pace with the accumulation of material, and the lack of well-ordered manuals and illustrative materials is a great hindrance to the effective organization of agricultural instruction.

(2) To promote the efficiency of agricultural instruction in the negro land-grant colleges, in order that the funds granted for negro education by the Federal Government may contribute toward keeping the negro on the farm and making him a more efficient factor in agricultural production for his own good and that of the nation, rather than, as is largely the case at present, drawing him away from the farm into the uncertainties and dangers of city life.

(3) To aid the agricultural organizations in the several States in promoting an efficient organization of agricultural high schools, consolidated common schools, and other educational agencies best adapted to secure a high state of prosperity and contentment in rural life. It is along these lines that the great educational effort of the immediate future is to be made. The forces behind the movement for industrial education have hitherto devoted themselves very largely to the promotion of instruction in the city industries. It is now apparent that a similar work needs to be done for the great fundamental industries grouped under agriculture. Much work will be required to bring the masses of our agricultural population into sympathetic touch with the progressive movement in education and to secure for them a school system in harmony with their environment and their relations to the world's work and civilization. As the nation's representative of agricultural enlightenment and progress, this Department should be in a position to render effective aid in this enterprise, on the success of which depends so largely the permanent prosperity and contentment of our agricultural people.

(4) Since the success of agricultural instruction in the public schools will depend very largely on the teachers, this Department should aid the agricultural colleges and other State educational institutions in preparing and inaugurating training courses for teachers of agriculture in secondary and elementary schools.

(5) Since agriculture as a fundamental industry is of vital importance to all our people, this Department should present such results of its work and that of the experiment stations at home and abroad as are adapted to instructional purposes in connection with nature study and elementary agriculture in a form available to teachers and pupils in both country and city, the object being to impress our youth with the dignity, value, and attractiveness of country life and pursuits.

#### THE FARMERS' INSTITUTES.

Interest in the farmers' institutes continues to increase throughout the country, and a larger attendance is reported for the past year than ever before. The Department is keeping in close touch with the State organizations under which the institutes are held, and is especially aiding the lecturers to obtain up-to-date information regarding the progress made in agricultural science and practice. In many localities there is a demand for more extended and definite instruction than



can be given in the ordinary institutes. The Department is therefore having short courses of lectures prepared by experts, which may be used in so-called movable agricultural schools. Inquiry is also being made regarding the value of various other means more or less extensively used for interesting farmers and their families in improved practice on their farms and in their households. Representatives of the Department have accompanied the special railroad trains which have carried exhibits and lecturers to thousands of farmers in many parts of the country, proving a popular and effective means of awakening interest in the work of the Department and the experiment stations. The farmers' institutes and other forms of what is often called extension work in agricultural education are very important supplements to the publications of the Department and the stations, as well as to the regular work of the agricultural colleges and schools. The Department should share in this extension work and seek to promote its general interests.

#### EXPERIMENT STATIONS IN ALASKA, HAWAII, AND PORTO RICO.

A systematic effort has been begun to determine the feasibility of the live-stock industry in Alaska. A small herd of Galloway cattle has been purchased and located at Kenai, in Cook Inlet, and at Wood Island. These cattle have subsisted during the summer upon the native grasses, and a considerable supply of grain hay has been grown at the Kenai Station with which to maintain them during the winter. Wheat, rye, barley, and oats matured in 1905 and 1906 at the Rampart Station in the Yukon Valley, but 300 miles farther south, in the Copper River Valley, cold and drought killed all but the hardiest varieties of cereals. A large amount of grain hay was obtained at the Copper Center Station and sold at a highly remunerative price. It has been shown that many of the Alaskan soils require lime, and a method has therefore been devised for the cheap local production of lime in small quantities. Arrangements have been made to open a station near the prosperous mining towns of Fairbanks and Chena, on the Tanana River, as soon as funds are available for this purpose.

The Hawaii Station reports an increasing appreciation of its efforts toward diversifying the agricultural industries of the islands, and as a direct result of three years' experimental work with tobacco it is said that this year fully 200 acres were planted. The discovery by the station chemist that Hawaiian feeding stuffs are deficient in lime is an important one, and will make it possible to arrange more satisfactory rations for live stock. The investigations on the marketing of tropical fruits promise to open markets in the Pacific coast, which can best be supplied from Hawaii. Investigations begun with the object of rehabilitating the rice industry have been so favorably received that private individuals have generously contributed considerable sums of money to aid in carrying them on.

The Porto Rico station is extending its influence, and requests for cooperative work are coming from numerous sources. While the income of the station has been too limited to enable it to meet these demands, yet they show a growing sentiment in favor of the station which is very encouraging. The coffee experiments have begun to show results, and the improved methods of pruning and cultivation are quite apparent in the increased yields obtained. A successful effort is being made to grow lowland rice, and this industry should be greatly extended. The Porto Ricans are large consumers of rice, most of

which is now imported. Among the forage crops experiments with cowpeas have been most successful, and it is believed that they can be grown throughout the island. Numerous horticultural experiments are in progress, and studies are being made of insect pests and plant diseases.

The work of the stations in Alaska, Hawaii, and Porto Rico is now so well established that they can profitably make use of increased funds. Considering the fact that all buildings, equipment, and live stock must be provided for these stations from the Federal funds, there is even greater need of more liberal appropriations for their maintenance than in the case of the State experiment stations. I therefore recommend that an appropriation be given to the stations in Alaska, Hawaii, and Porto Rico equal to the amount given the State stations under the Hatch and Adams acts.

#### PROGRESS IN NUTRITION INVESTIGATIONS.

The investigations on the food and nutrition of man, conducted in different States and Territories under the auspices of the Office of Experiment Stations, have, as in the past, been carried on in cooperation with universities and other schools, as well as public institutions, but chiefly with agricultural experiment stations and agricultural colleges. By this cooperation the Department funds have been materially supplemented in various ways and the scope and possibilities of the work greatly increased. The chief object of the investigations is to learn the nutritive value of agricultural products of animal and vegetable origin and the proportions in which such food materials of different kinds may be most intelligently used to the advantage of both producer and consumer. The general policy has been to undertake, in the different centers of investigation, work for which the institution or region offered exceptional facilities. Thus, at the California Agricultural Experiment Station studies have been undertaken with fruits and nuts and the products made from them; at the Minnesota and Maine experiment stations with wheat, corn, and other cereal foods; at the University of Tennessee with cowpeas and other legumes; and at Wesleyan University, Middletown, Conn., with cheese made and cured in different ways. New experiments have been undertaken whenever the finishing up of any line of work has rendered this possible, and it has been the purpose to select for study especially those problems which have a direct bearing upon agriculture.

The experiments which have been conducted at the California Agricultural Experiment Station have furnished additional evidence of the considerable amount of nutritive material which may be supplied in readily digestible form by fruits and nuts intelligently used as part of the diet. It appears further that fruits and nuts are more useful when eaten in combination with other food materials than in large quantities by themselves or at the end of an otherwise hearty meal.

The studies of cereal breakfast foods undertaken at the Maine and Minnesota experiment stations have shown that different classes of goods made from the same grain do not differ materially in nutritive value though there is a considerable range in price. As a whole, cereal breakfast foods are nutritious and reasonably economical. As regards digestibility they closely resemble bread made from the coarser flours and are somewhat less thoroughly assimilated than bread made from white flour. It has also been shown that flour products other than bread closely resemble bread in digestibility and total nutritive value.

From studies with corn products, undertaken at the Maine Experiment Station, it appears that corn bread of different sorts has about the same digestibility as bread made from coarse wheat flour, and that it is well worthy of a place in the diet as a reasonably inexpensive source of nutritive material, as well as for the sake of variety.

The studies of different methods of cooking meat carried on at the University of Illinois have shown that it is possible to control cooking processes so that a fairly uniform product may be obtained when similar cuts of meat are cooked by either boiling or roasting. As a whole, meats of different kinds and cuts supply nutritive material, particularly protein and fat, in forms which are very well assimilated.

Investigations on the digestibility and nutritive value of cheese carried on at Middletown, Conn., have shown that cheese (American cheddar) is very thoroughly assimilated and is not productive of digestive disturbances as commonly supposed. When desired it may be used in comparatively large quantities as an inexpensive source of protein and energy in the diet. Cheese, being rich in protein and fat, should be combined with cereal foods, fruits, and similar products, which supply an abundance of carbohydrates, and when eaten in considerable quantities should replace rather than supplement such nitrogenous foods as meat, eggs, and dried legumes. The experiments furnish the first extensive demonstration by scientific methods of the high nutritive value of this important dairy product. The great importance of cheese as a source of protein has not been hitherto appreciated and in a sense its commercial value as a food has lacked satisfactory basis.

The investigations carried on with the respiration calorimeter at Middletown, Conn., have furnished new and valuable factors regarding the average amount of energy in the form of food required by men at rest and performing various kinds of work, the carbon dioxid and energy output at different times of the day under different conditions of work and rest, and related topics.

The investigations undertaken at the Hawaii Agricultural Experiment Station have furnished interesting data regarding the nutritive value of tropical food products and the kinds and amounts of food consumed by persons living under different circumstances in tropical regions.

At Columbia University, New York, the investigations which have been undertaken furnish new and valuable data regarding the demands of the body for the ash constituents of food.

The results of the nutrition investigations are made public by means of technical bulletins and popular summaries, and a great deal of miscellaneous information is also supplied to teachers, students, and other persons by means of correspondence, the increasing demand for publications and other data being an indication of the favorable way in which the work is regarded by the people at large.

Extended use has been made of the nutrition publications as text-books in a large number of schools, colleges, and medical schools throughout the country, owing to the fact that satisfactory text-books on these subjects have not hitherto been available. In this connection it may be mentioned that there are 45 agricultural colleges or similar institutions receiving Government aid for white students, and an equal number for colored people, where some of the courses of instruction necessitate the use of such data.



The proper economical feeding of families or groups—that is, the best methods of utilizing the food products which come from the farm—is a subject the importance of which can hardly be overestimated, and a knowledge of the important facts regarding the nutritive value of different foods can not fail to bring about improved standards of living on farms and elsewhere and benefit alike the producer, the distributor, and the consumer of food products.

#### IRRIGATION AND DRAINAGE INVESTIGATIONS.

Three years ago the Office of Experiment Stations detailed some of its irrigation experts to work out and introduce the right methods of irrigation in some of the older districts where water is scarce and costly and where skill and economy in its use are of the utmost importance, and also took up giving practical advice to beginners in irrigation in sections where irrigation was being introduced. The conditions under which these men worked therefore were widely different, but the results have been the same in each case. Wherever this educational work was begun there has been a marked appreciation of its value. Each one of these men has become a fixture in the State and section where he was first located. Every attempt to send him to a different section to take up this work has been met by protests and remonstrances which could not be disregarded. The result has been that requests for similar work in other localities made by Members of Congress, governors, and communities could not be responded to, although the value of the work and the reasonableness of the requests were fully appreciated. To meet these demands the number of men engaged in this work should be increased during the coming year.

Thus far this work has been carried on entirely in aid of settlers under private works, but it is believed that the time has come when this Department should take up the work of educating and aiding settlers under Government reclamation projects, and that experts should be detailed to these projects to show the methods of applying water which should be adopted, the kind of tools to be used, the time when land should be irrigated, the quantity of water which should be used, and the cultivation which should follow this use.

The experience of the past few years has also shown that this educational work and the successful conduct of original investigations can both be best carried on through the establishment of farms where the best methods can be worked out and illustrated and their results demonstrated. While bulletins and reports are of great value, they are not equal to an object lesson. Nothing will teach these farmers how they should do their work so quickly as to be able to see fields prepared in the right way, water handled in the right way, and the soil cultivated in the right manner. I believe therefore that on each reclamation area a demonstration farm should be established, on which the methods of irrigation can be taught by a practical expert from this Department, and trust that provision will be made for this by the next Congress.

Five irrigation extension stations for the demonstration of methods of using groundwater and flood and storm waters in irrigation as supplementary to dry farming have been located in the semiarid belt during the past year. At these stations it is expected to work out and demonstrate the methods and practices for utilizing limited water supplies in the irrigation of from 1 to 10 acres of land, and the methods of irrigation and tillage needed to conserve this moisture in the

soil, and the benefits which will come by making such irrigation a feature of every semiarid farm. This work has assumed a new importance because of the great wave of settlement which is now sweeping over this region.

A number of influences, some of them proper and some questionable, are aiding in this settlement. Among those that are legitimate are the greater possibilities due to the introduction of drought-resistant crops, the improved methods of tillage, and the series of wet years with which that section has been favored. But there will come other dry years, and the permanent prosperity of these settlers will largely depend upon their having fortified themselves against the risk of drought by utilizing every opportunity for a water supply that the region affords. Nothing will aid more to enhance their comfort or relieve them from the danger of dry years than to have from 1 to 10 acres of land irrigated where crops can be grown regardless of the rainfall. Provision for such irrigation will enable the farmer to grow trees for fruit and shade, have a limited area of high-priced products, enough vegetables for his family, and forage for his cows and horses. It will also enable him to make the surroundings of his homestead attractive, thus adding to the comfort and contentment of country life in these regions.

That the demonstration farm is an effective influence in promoting the extension of this kind of irrigation has been proven by the results of the oldest of these stations, located at Cheyenne, Wyo. This station, through the utilization of underground waters lifted by windmills, has produced crops equaling those of the old irrigated districts. It has shown the extent and value of water resources hitherto neglected. The station was visited during the year by fully 5,000 people, and its methods and results observed and described in a large number of scientific newspapers and magazines, as well as in the local press of that region. It has encouraged a large number of farmers to conserve and utilize water supplies which were hitherto going to waste, and the year's results are considered as marking the beginning of a new era of agriculture in that section.

In many parts of the arid and semiarid region water for irrigation can be secured only by pumping. The Department has a constant call for information as to the cost of such irrigation and the types of pumps and the kind of power which should be used. We have collected a large amount of information on these subjects, which is now being prepared for publication, and recently have inaugurated some comprehensive tests to determine the value of alcohol as a power agent in pumping water for irrigation and drainage, and in other agricultural work, with a view to giving practical information to farmers about the value of denatured alcohol as compared to gasoline, and the conditions under which it should be used to secure the maximum efficiency.

Every year the area of irrigated land that needs drainage is increased, which proves that irrigation and drainage must go hand in hand. During the past year the Department has been carrying on extended drainage investigations of some of the irrigated districts injured by surplus water in Utah, Washington, Nebraska, and California, this work being paid for in part by State appropriations. These investigations have been carried on as a preliminary step in the preparation of drainage plans.

The past year has also demonstrated the benefits of good engineering in securing the efficiency of drainage as a remedy for alkali. The drains put in by the farmers of Utah on lands which were regarded as ruined by alkali have so relieved the lands in a single year that they are now ready for cultivation, and land drained three years ago according to plans prepared by the engineers of this Department, this year produced \$75 worth of sugar beets to the acre. Equally encouraging results on a larger scale have followed the carrying out of the plans of the Department's engineers in the State of Washington.

The drainage of the swamp overflowed lands in the humid parts of the United States would extend or greatly improve agriculture over an area almost equal to that of the States of Illinois, Indiana, and Ohio. This makes farm drainage a matter of National interest and importance. Nor will the increase in agriculture mark the full measure of the benefits of this drainage. Many of these swamps are a menace to the health of surrounding neighborhoods and a great obstacle to the development of commerce and manufacturing. The reclamation of some of these areas, like the coastal swamps of the Carolinas, the Everglades of Florida, and the St. Francis Basin in Arkansas, presents agricultural and engineering problems of great complexity, which can not be solved by private enterprise; the cost and the area of country involved are both too great. As a rule agricultural drainage requires special legislation to provide for the organization of the district to be benefited and the raising and expenditure of funds under public or semipublic authority. The general interest manifested in drainage in this country, with the large amount of work done at present, has given rise to many important questions, legislative, financial, engineering, and agricultural. The calls on the Department along these lines have been far greater than could be met. During the past year it has rendered important aid by conferences with State officials and others in making surveys and investigations to determine the feasibility of large drainage projects and prepare plans for the work. During the year this Department has carried on these surveys and investigations in thirty-one of the forty-six States.

#### OFFICE OF PUBLIC ROADS.

Throughout the country, and more particularly in the rural districts, there is a steadily growing demand for information as to the best methods of road construction. Considering the country as a whole, it is probably true that in no phase of development are we so backward as in the extension of hard and durable roads. In the cases in which the people are willing to expend money on the improvement of their highways, it frequently happens that, owing to inexperience and lack of organization, the money is partially or totally wasted. In some communities abundantly able to support a system of good roads, very little work is done, owing to a lack of knowledge of what can be accomplished with the resources at hand. It is precisely in cases like these that the work of the Office of Public Roads is proving of signal value. While it is no part of the scope of its work to undertake the construction of roads that can be and should be the care of communities within the States, the educational value of employing expert supervision, as well as, to a limited extent, machinery for the construction of sections of improved roads in different parts of the country, has been amply demonstrated.



The act of Congress making appropriation for the Office of Public Roads makes three distinct requirements in relation to the work to be performed, viz, to investigate systems of road administration throughout the United States, to give expert advice on road construction, and to investigate the chemical and physical properties of road materials. During the past year the work of the Office has been arranged in three general divisions along the lines indicated.

The Office is also collecting information as to comparative cost of road work, methods of building various types of roads, State-aid roads, legislation regarding road management, the value of wide tires, the use of convict labor in road building, cost of wagon transportation, and bond issues for road improvement. Numerous inquiries are received asking for information on the subject of the road laws of the various States, and a complete digest of the road laws of all the States is being prepared for publication.

#### EXPERT ADVICE ON ROAD CONSTRUCTION.

Expert advice on road construction has been given and experimental field work carried on by the Office. There were employed on this work at the close of the fiscal year, in addition to the chief engineer, 3 engineers, 1 consulting engineer, 6 engineer students, 6 road experts, and 5 expert roller operators. Whenever it is possible and where application has been made in the proper way, object-lesson roads are constructed for the purpose of illustrating the best methods of road building. The local authorities furnish all material, common labor, teams, and fuel, the Office supplying supervising engineers and in some cases part or all of the necessary machinery. In addition to this, tests are made to determine the best material available for the road. It frequently happens that these short sections of object-lesson roads have subsequently led to the construction of fine systems of improved roads in the localities in which they were built. During the past fiscal year 17 roads were built in 11 States, representing a wide diversity in character of construction and kinds of material used.

In many cases in which it is not deemed advisable to undertake the construction of an object-lesson road, engineers and experts of the Office are able to give advice that enables local authorities to improve the conditions and surmount difficulties. It is evident that where only small amounts of money are available for road improvement it is frequently better to improve the highways already existing than to attempt the construction of macadam roads. Special attention has been given to this phase of the work and the Office has been able to do much in developing the use of sand clay and burnt clay for roads in large areas of country, especially in the South, where no stone is available.

In order to give expert advice on special problems which are continually arising in road construction and maintenance, it is necessary to carry on experimental work. During the past year methods of rendering roads dustless have been investigated. The growing use of motor vehicles has presented a new and difficult problem to engineers and road builders. Systematic experiments were carried on at Jackson, Tenn., during the spring and summer of 1905, in cooperation with the city engineer, to determine the value of coal tar for preventing dust and preserving the surface of macadam roads. Tests were also made with Texas oil and its residuums on earth and macadam roads. The

expense entailed in these experiments was small. The quantity of tar applied per square yard averaged 0.45 gallon and the cost of labor for applying this quantity of tar was less than 1 cent per square yard. After more than seven months, including the winter season of 1905-6, the tarred roads are still in excellent condition.

Additional experiments were conducted during the summer of 1906 on the Potomac River drive in Washington, D. C., in cooperation with the Superintendent of Buildings and Grounds. Crude coal tar similar to that used at Jackson, Tenn., was used in this work. These experiments have been completed but a short time. The great demand which exists all over the country for some sort of treatment of road surfaces to suppress the growing dust nuisance has developed a number of materials which it is claimed will answer the purpose. Many of these materials, which are mainly emulsions of oil and tar with water, have been given trade names and patented. It is to be hoped that careful experiment will show that some material like crude coal tar, which can be obtained and easily applied wherever there is a gas plant, will prove to be efficient if properly used. It may be said that a large number of trials of crude tar in France and a few in this country, notably the one at Jackson, Tenn., have given excellent results. In other cases partial or entire failure has followed the experiments, and it yet remains to be determined whether the successful use of materials of this nature can be developed. The Office will make unremitting efforts to solve this problem by such experiments as can be carried on in different parts of the country in cooperation with local authorities.

In order to recruit the ranks of engineers that are necessary to the success of the work of the Office, the plan was adopted of appointing graduates from civil engineering schools to the positions of civil engineer students, as fully explained in the annual report of the Office of Public Roads for 1905. Up to June 30, 1906, nine students had been appointed, at \$600 per annum. Of this number three have been given permanent appointments at increased salaries. The other six have not yet completed the one-year course.

A number of schools and colleges have within recent years established summer schools in road building.

#### INVESTIGATION OF THE PROPERTIES OF ROAD MATERIALS.

During the past year 384 samples were received at the laboratory for routine tests, of which number 273 were samples of rock, intended for macadam road building. Of the 273 samples, about 42 per cent were limestone, 11 per cent dolomite, 10 per cent trap, 8 per cent sandstone, and 8 per cent granite. The remaining samples were of a miscellaneous character, including brick, cements, and sand. Some of this testing work is done in cooperation with various Departments of the Government. A comparison of the demand for tests with the records of previous years shows that it has increased about 33 per cent.

A significant fact, in connection with the laboratory work, is that a very large number of samples have come from the Eastern and Middle States, which have not received much assistance in the form of object-lesson roads. This tends to distribute uniformly the benefit arising from the work of the Office.

There is a growing amount of cooperation between the various State geologists and the Office in the preparation of data showing the character of material suitable for road work in the different States. From one State alone more than 80 samples have been tested. The information thus secured has been used in a bulletin, recently prepared and published by the geologist in charge, on the road-building resources of this State. Chemical and physical examinations have included practically all materials which directly or indirectly come into use in road construction.

The studies of decomposition of various kinds of rock dusts under the action of water, which were undertaken in order to determine the reasons for the important quality of binding power in macadam-road materials, have brought to light some specially interesting facts. For instance, it has been found that by mixing certain rocks of inferior binding power on the surface of the road a much higher binding power results, as in the case of limestone and granite. As the binding or cementing power of rocks is one of the chief factors in the life of a road, the value of this discovery is of obvious importance. These results, originally obtained in the laboratory, have been confirmed by observation and experiment on roads. In the course of this investigation it was found that the decomposing action of water on certain types of ground rocks went much further than had been previously believed to be the case. This applies to the alkalies, and especially the potash, contained in many rocks. The results have suggested the possible use of ground rock as a potash fertilizer. Work along this line has now been turned over to another Bureau of the Department, where it can be appropriately followed up and carefully investigated.

Owing to the numerous complaints of farmers in regard to the rapid deterioration of the modern fence wire in comparison with that manufactured in former years, an investigation of the subject was begun to see what could be done to remedy the defect. Farmers' Bulletin 239 contains a report of this investigation, which has aroused the interest of manufacturers and has determined some of them to take active steps toward producing a fence wire more resistant to atmospheric corrosion.

The scarcity of timber in many sections of the country, not only for construction work, but for fence posts, has in recent years led to a more general use of concrete. This material is admirably adapted for farm purposes, but there seems to be a general lack of knowledge concerning its preparation and use. After a series of tests and investigations, Farmers' Bulletin 235 was issued, giving full information concerning cement, cement mortar, the mixing of concretes, and the construction of concrete sidewalks, driveways, fence posts, etc. A number of persons throughout the country who claim to have obtained special patents on concrete fence posts have attempted to prevent farmers from constructing their own posts by threats of prosecution for infringement. In view of the fact that concrete construction of all kinds reenforced with plain, straight, metal strips, bars, and tubes has been in general use in all countries for many years, the claims of such persons are usually without warrant. The Office has been enabled to be of great service to farmers by making it clear to them that, unless special forms and devices of reenforcement were employed which were



distinctly patentable, no rights were infringed by the use of concrete with plain metal reinforcement.

Before being assigned to work in the field the engineer students employed in the Office receive a course of instruction in the testing laboratory. This work consists in actually making the various tests of road materials and computing results. The information thus obtained is considered necessary in connection with the selection of the best materials for road construction before a thorough understanding of the relations which exist between laboratory tests and the behavior of these materials under traffic can be gained.

A number of new projects and lines of investigation have been mapped out for the immediate future.

Outside of the laboratory a study of road machinery will be undertaken to determine the suitability of various types for different kinds of road work.

Cooperation will be sought with the Geological Survey for the purpose of indicating the various classes of roads on topographic maps issued by the Survey. Cooperation has been begun with the Forest Service in laying out and constructing wagon roads and trails in forest reserves to facilitate lumbering. As a beginning one engineer has been detailed to this work and has been some months in the Yellowstone Reserve. The field report indicates that much good will follow the preliminary survey which has been made.

Cooperation with the Post-Office Department has been begun in order to facilitate rural delivery by the improvement of country roads. This work is of vital importance. The plan, which carries the approval of the Secretary of Agriculture and the Postmaster-General, provides that whenever a road upon which a rural route has been or is about to be established is reported by the carrier or inspector to be impassable or in bad repair, the Fourth Assistant Postmaster-General will advise the Director of the Office of Public Roads of the fact and request that he have an engineer inspector detailed to examine the road and give such advice and instruction to the local officials as may be required.

Upon receipt of such information from the Fourth Assistant Postmaster-General, the Director of the Office of Public Roads will communicate with the local officials and supply them with a copy of the circular of instructions and a blank form for making application for the detail of such engineer inspector. It is not the purpose of the Office of Public Roads to actually construct the road or to make any contribution in money, materials, or labor. In most cases a road is impassable on account of defects which can be remedied by the use of proper methods. The engineer inspector who examines the road will note carefully all such defects and advise as to what steps can be taken to place the road in proper condition without great expense. If practicable, and if so desired, he may in some cases assume temporary direction of the work for the purpose of instruction.

As the chief aim and purpose of the Office of Public Roads is to bring about a general and uniform improvement of the country roads throughout the United States, a cooperative plan such as the one described above offers the best possible means of achieving positive results in furtherance of that purpose. By this means correct methods of road building and road maintenance will be introduced into practically every section of the country. The engineer inspectors assigned to this work will, in visiting places which have requested assistance of this charac-

ter, follow an itinerary which will include a number of places in a given territory. This will greatly minimize the expense of each inspection and permit the inspector to cover a much larger territory than would be possible in a special assignment to each place. A beginning has been made during the current fiscal year, and efforts will be made to increase the scope of the work in the future.

#### EXPENDITURES AND EMPLOYEES.

Congress appropriated \$7,175,690 for the maintenance of the Department of Agriculture for the year ended June 30, 1906. This was \$1,081,150 more than the appropriation for the preceding year. In addition the Department received from various sources, chiefly sales of products, \$15,473.45. At the close of the year there was still unexpended, of the appropriation, \$1,175,362.15, nearly all of which will be required to meet outstanding obligations. The unexpended balance for the year 1904 (\$55,712.37) was, on June 30, 1906, covered into the Treasury. The account for 1905 was still open. Of the special appropriations aggregating \$1,250,000 for new buildings, \$642,107.25 had been expended prior to September 10, 1906.

For the current year (ending June 30, 1907) Congress appropriated \$9,210,440 for the regular work of the Department. The increase is chiefly due to the broadening of the meat inspection. For that service the permanent appropriation is \$3,000,000. The estimated revenues of \$700,000 from sales of products of the forest reserves and \$780,934.68 available for the new buildings bring the total amount to be disbursed by this Department during the current year up to \$10,691,374.68.

The number of persons on the rolls of the Department of Agriculture on July 1, 1906, was, outside of Washington, 4,648; in Washington, 1,594; total, 6,242, showing an increase during the year of 796. Of the total number, more than 1,800 have been on the rolls for six years or longer. In the classified service 917 were promoted in salary and class, and 403 resigned. The total number of deaths during the year was 28.

#### NEW BUILDING FOR THE DEPARTMENT.

The act approved February 9, 1903, authorizing an appropriation of \$1,500,000 for a new building, made possible the beginning of the construction of suitable quarters for the accommodation of the Department's work.

It was very necessary in the new building operations to make arrangements for future requirements, and with this in mind, together with the imperative need for suitable laboratories to carry on the important investigations of the various Bureaus, it was concluded to erect two segments of a building, so arranged that extensions could be provided as required, these segments to be used primarily for laboratory work and to provide fireproof accommodations for the Library. Contracts have been awarded for structures of suitable type and design to correspond with other Government buildings in the city, the base being constructed of granite and the superstructure of white marble.

The work has now progressed, with the exception of the interior finish, to approximately the fourth-floor line, and it is probable that

the roof will be on before the winter season. The roofing and closing in will allow the interior work to be carried on during the winter without interruption, which, without unforeseen complications, will insure the completion of operations within the contract time, namely, November 14, 1907, and within the \$1,500,000 authorized by Congress. The mechanical equipment work, including the heating and ventilating apparatus, the electric wiring and conduit systems, and the electric elevators, has been started, and these systems will be ready for use at the time of the completion of the buildings.

The estimated growth of the Department, made at the time the appropriation for the new building was approved, has been greatly exceeded. Statistics show that there has been during this period of approximately three and one-half years, exclusive of the Weather Bureau, an increase in the number of employees of from 1,037 to 1,483 in Washington, D. C., making a percentage increase of 43. Further, the space required by this force of employees has increased from 137,963 square feet to approximately 264,000, this being a 99 per cent increase, and the rentals paid from the Department appropriation have increased from \$21,700 to \$54,408.96, or over 150 per cent.

This rapid increase will require other segments of the proposed buildings to be constructed before the Department will have sufficient and suitable accommodations for its work and before the large amount paid annually for rentals can be substantially decreased.

To carry on the work of the Department in an efficient manner on the lines laid down in the foregoing report has necessitated provision for somewhat increased appropriations. This report will fall short of its purpose if it has not made clear the importance of the interests the Department is designed to serve, and the necessity for carrying on its work. Moreover, the duties devolving upon it are imposed upon it by law, and it is with full appreciation of these several considerations that estimates for its expenses must be viewed. The estimates for the ensuing year have been most conservatively prepared, based upon the lines of work imposed upon the Department by the Congress, and I earnestly commend them to the favorable consideration of that body.

Respectfully submitted.

JAMES WILSON, *Secretary.*

WASHINGTON, D. C.,  
*November 24, 1906.*



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DEPARTMENTAL REPORTS.

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## REPORT OF THE CHIEF OF THE WEATHER BUREAU.

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U. S. DEPARTMENT OF AGRICULTURE,  
CENTRAL OFFICE OF THE WEATHER BUREAU,  
*Washington, D. C., August 30, 1906.*

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1906.

WILLIS L. MOORE,  
*Chief of Weather Bureau.*

Hon. JAMES WILSON, *Secretary.*

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### OPERATIONS OF THE YEAR.

#### FORECASTS AND WARNINGS.

Weather forecasts for thirty-six and forty-eight hours in advance have been made daily throughout the year for each State and Territory, and special warnings of gales on the seacoasts, Gulf and Great Lakes, and of cold waves, frost, heavy snows, floods, etc., have been issued when the advices were calculated to benefit commercial and agricultural interests. The North Atlantic and West Indian storm-warning service was continued, and forecasts for the first two days out for steamers bound for European ports were issued daily at 8 a. m. and 8 p. m.

The material necessary in the forecast and warning service has been gathered twice daily by telegraph and cable from about 160 stations in the United States, 19 in Canada, and about 20 in the islands of the Atlantic and on the western coast of Europe; in all, about 200 reports have been received in the morning and a lesser number in the evening. Eight forecast centers have been maintained, one each in Washington, D. C.; Boston, Mass.; New Orleans, La.; Louisville, Ky.; Chicago, Ill.; Denver, Colo.; Portland, Oreg., and San Francisco, Cal. Although no important change has been made during the year, either in the character of the available material or in the manner of its application to the problem in hand, constant effort has been put forth to improve the forecast service. In another portion of this report reference will be made to the work accomplished in the way of seeking new physical data, both solar and terrestrial, in the hope of successfully applying them to weather forecasting.

It was the hope of leading meteorologists some twenty years ago that a study of the pressure distribution over the globe, especially the shifting of great air masses in latitude and longitude, would yield valuable results. In more recent years the subject has been further



pursued and a fairly close relation has been established between the pressure distribution over the Atlantic and the character of the weather over western Europe. In this country studies of atmospheric pressure distribution in the United States in its relation to long-period fluctuations in temperature and rainfall have been made by Garriott, Fassig, Henry, and McAdie. In general, however, these studies did not attempt to deal with the relation between current weather conditions and pressure distribution over continental and oceanic areas, for the reason that daily barometric readings from oceanic areas were not available. Cable connection with the Azores was effected a year or so since, and, within the year just closed, communication with Honolulu was established. Reports from these stations, including Bermuda and the west coast of Europe, throw considerable light upon the atmospheric movements in the United States, and the study of these movements in the light thus afforded is the distinctive work of the year. The result has been sufficiently encouraging to warrant its further prosecution and a still further enlargement of the field of view by the courtesy of foreign meteorological services.

#### ENLARGEMENT OF THE FIELD OF OBSERVATION.

Already correspondence has been entered into with the director of the physical observatory, St. Petersburg, Russia, with a view to securing daily reports from Siberia, the seat of the great winter area of high pressure in the Northern Hemisphere.

The Bureau also has in preparation a plan of organization for a service in Alaska by means of which prompt advices may be received of changes in the Bering Sea area of low pressure, which are intimately associated with the weather of the United States.

The extension of the field of observation over the adjacent oceans is not yet fully developed. The essential features of this service provide for the collection, by means of wireless telegraphy, of simultaneous meteorological observations from vessels at sea, and the dispatch of weather forecasts and storm warnings to all vessels within the zone of communication that are equipped with wireless apparatus. The details of the plan have been worked out, and arrangements have been made with the Marconi Wireless Telegraph Company of America and with the American De Forrest Wireless Telegraph Company to transmit the observations from the vessels to the Weather Bureau at a stipulated rate; also to transmit weather forecasts and storm warnings from the Weather Bureau to vessels at sea without charge.

The service was placed in tentative operation aboard the vessels of the American Line December 1, 1905, the first dispatch being received from the steamship *New York*, Captain Roberts, December 3, the position of the vessel at the time being latitude  $40^{\circ}$  N., longitude  $60^{\circ}$  W., or about 600 miles east of Sandy Hook.

Subsequently the service was extended to the following-named vessels of other lines, all equipped with the Marconi apparatus, viz:

North German Lloyd: Steamships *Grosser Kurfurst*, *Kaiser Wilhelm II*, *Kaiser Wilhelm der Grosse*, *Kronprinz Wilhelm*.

Hamburg American Line: Steamships *Amerika*, *Bluecher*, *Deutschland*, *Kaiserin Augusta Victoria*.

Cunard Line: Steamships *Campania*, *Carmania*, *Caronia*, *Carpathia*, *Etruria*, *Iernia*, *Lucania*, *Pannonia*, *Slavonia*, *Ultonia*, *Umbria*.

White Star Line: Steamships *Baltic*, *Cedric*, *Celtic*, *Majestic*, *Oceanic*.

All the above-named vessels, including the steamships *New York*, *Philadelphia*, *St. Paul*, and *St. Louis*, of the American Line, are now authorized to transmit their daily Greenwich mean noon observations to the Bureau.

The privilege has also been extended to the following vessels equipped with the De Forrest system:

Panama Railroad and Steamship Line: Steamships *Advance*, *Alliance*, *Colon*, *Finance*, *Panama*.

Mallory Line (New York to Galveston): Steamships *Concho*, *Denver*, *San Jacinto*.

The service and code have also been adopted by the U. S. Navy Department, and all vessels of the U. S. Navy are instructed to transmit the daily weather dispatch while at sea. The wireless telegraph stations controlled by the Navy Department are also required to receive weather messages from merchant vessels and to transmit them to the Bureau, likewise to dispatch the weather forecasts and storm warnings issued by the Bureau to vessels at sea demanding them, free of cost.

The service in connection with the merchant marine is not yet in good working order, owing to its novelty, the inexperience of both observers and operators, and other considerations of a financial character.

#### EXTENSION OF STORM-WARNING SERVICE.

The storm-warning service has now been extended to include all wireless telegraph stations of the Navy Department along the coasts of the Atlantic, the Pacific, and the Gulf of Mexico. These stations receive storm-warning messages from the Weather Bureau and transmit them to light-ships and vessels in the zone of communication that are equipped with wireless apparatus. A similar service has also been inaugurated with the Marconi company by means of which its stations transmit to vessels equipped with the Marconi apparatus messages containing storm advices.

Ten additional storm-warning display stations have been furnished with steel towers and high-power lanterns for night displays. One hundred and seventy-two display stations on the Lake, Gulf, and sea coasts of the United States are now provided with improved apparatus for the better display of storm warnings. No station of any importance to shipping and commercial interests remains to be equipped, and this important work, which was begun in 1900, is now practically complete.

#### STORMS OF THE YEAR.

The most important and only severe tropical storm of the year advanced from the Caribbean Sea, south of San Domingo, northward over the eastern Bahamas, and thence northeastward over the Atlantic Ocean during the early part of October, 1905. On the 11th, when this storm was central near the eastern edge of the banks of Newfoundland, the steamship *La Savoire* reported the remarkable barometer reading of 27.92 inches, and the steamship *Campania* encountered a disastrous storm wave. Advices to West Indian, Atlantic, and Gulf coast interests regarding the storm were begun with its first appear-

ance over the Caribbean Sea and continued daily until it recurved northeastward over the Atlantic Ocean, when advices to Canadian maritime ports were begun and continued until the center passed Bermuda. Lloyds, London, was also advised that a severe tropical storm was moving from Bermuda northeastward toward the trans-Atlantic steamship routes.

In the autumn of 1905 the Lake region was visited by several storms of exceptional severity, in connection with which the work of the Weather Bureau was conspicuously valuable. Ample and timely warnings were issued of severe cold waves and damaging frosts, and, in the Southern States especially, the advices were of great value to garden and trucking interests.

A notable advance in the frost-warning service has been made in the cranberry districts of Wisconsin, Massachusetts, and New Jersey, where special observations of air and soil temperatures are being utilized to improve the accuracy of the forecasts during the growing season.

#### RIVER SERVICE.

No important floods occurred during the year. Action has been taken to extend the river and flood service in California and South Carolina, and the river and special rainfall stations of the country as a whole have been improved as the needs of the service demanded and the fund permitted.

#### DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

First and foremost in the effective distribution of daily weather forecasts and special warnings are the daily newspapers and the various press associations. Closely following these in importance is the telephone, not only in rural districts but also in the great centers of population. During the year just ended over half a million telephones were added to those already receiving forecasts and warnings through the telephone exchanges.

Aside from the distribution through the press associations, the daily newspapers, and the telephone, it has been found necessary to telegraph forecasts and warnings direct to a number of places in the different States and Territories at the expense of the Bureau, it being impossible to serve the interests involved through the press associations. The number of addresses in the United States to which forecasts and special warnings are sent by telegraph is 2,150. Special warnings only are sent to 767 addresses, and emergency warnings, *when issued*, to 5,998 addresses. Distribution without expense to the Bureau is made to 76,719 addresses by mail, to 82,466 by mail through the rural free-delivery service, to 1,014,285 by telephone, to 2,145 by railroad telegraph lines, and to 2,514 by railroad train service.

#### INCREASE IN THE NUMBER OF METEOROLOGICAL STATIONS IN THE UNITED STATES.

This report would be incomplete without mention of the great increase in the administrative work involved in the operation and maintenance of a central office in the city of Washington and 187 first-order stations at various outlying points, the latter employing in all



513 persons. The number of first-order stations ten years ago was 131. The increase is due to a constantly growing demand for weather information from various parts of the country hitherto not occupied by a reporting station of the Bureau. Aside from the stations above named, the Bureau employs nearly 900 persons at nominal salaries for the following purposes, viz, 160 for the display of storm warnings along the seacoasts and the Great Lakes; 340 persons in taking observations of river stages and rainfall; 107 persons in taking rainfall observations on the headwaters of various streams; 154 persons in taking observations of the weather in the cotton-growing States; 133 persons in taking observations of the weather in the corn and wheat growing States; in all, 897 noncommissioned employees, all of whom, however, devote probably less than half an hour daily to the service of the Bureau.

In addition to the above, the climatic conditions in the United States and its outlying possessions are being recorded at about 3,700 points known as cooperative stations. The most important climatic elements, viz, temperature and precipitation, are observed at these stations with standard instruments and the general weather conditions are carefully noted and recorded. The total number of points within the United States, at which observations suitable for a discussion of the climatic conditions of the country are taken, is therefore about 4,500.

#### ESTABLISHMENT OF NEW CLIMATIC STATIONS AT HIGH LEVELS.

An effort was made during the year to establish, through the cooperation of the Forest Service of the Department, a number of stations on mountain ranges, with a view of determining the amount of precipitation and the temperature conditions at high levels. Thus far the results have not come up to expectation.

#### THE DISTRIBUTION OF METEOROLOGICAL INFORMATION.

The immense output of meteorological information that comes from the various stations maintained by the Bureau is exhibited to the public in various ways. The daily output finds its way to the public mainly through the columns of the newspapers and in the maps and bulletins issued at Washington and outlying stations. The daily issue of maps in Washington is about 1,625 copies. Outside of Washington there are 105 stations, which issue an aggregate of 25,000 maps daily, making a yearly issue of over 8,000,000 copies.

During the crop-growing season a weekly résumé of the weather conditions in all parts of the country is printed and distributed in the form of State and National weather bulletins. The National Weather Bulletin, of which 2,500 copies were issued June 30, 1906, contains a statement of the weather conditions over the entire country; while the State or district bulletins, of which 31,190 were issued at 44 centers on June 30, 1906, give a résumé of the weather conditions in the State or district only.

#### CHANGE IN NATIONAL AND STATE BULLETINS.

During the year all matter relating to crop conditions was eliminated from the weekly and monthly weather bulletins issued at the



section centers, and at Washington, D. C., in order that more emphasis could be placed upon the meteorological conditions prevailing in the various States and Territories.

#### PRINTED REPORTS OF WEATHER CONDITIONS.

As above stated, the daily weather conditions are printed in some detail on the daily weather maps, but inasmuch as the supply of maps is necessarily limited and there is no issue on Sundays or holidays, each section center, of which there are 44, prints a monthly summary of weather conditions, including a statement of the highest and the lowest temperature and the total precipitation for each day of the month, so that the important climatic features in all parts of the country are made of record and can be found in print.

The number of monthly climatological reports printed at the various section centers is 30,944, being an average of about 700 copies each per month.

#### MONTHLY WEATHER REVIEW.

In the same category, but on a somewhat larger scale, the Weather Bureau publishes in the Monthly Weather Review a résumé of the weather in the United States, as shown by the reports of about 4,500 stations. This publication has been issued regularly under the editorship of Professor Abbe. In addition to the climatological tables and charts, it contains a report on the work relating to forecasts and warnings, rivers and floods, and a summary of the weather for the month. It is also a medium of communication for the exchange between members of the service of views and experiences in Weather Bureau work. Distinguished meteorologists outside of the service have freely contributed to its columns, so that it has become recognized as an important aid to the officials of the Bureau.

#### METEOROLOGY OF THE OCEANS.

As stated in my last report, the control of meteorological work on the oceans was transferred from the Navy Department to the Department of Agriculture, and assigned to the Weather Bureau. The function of the Weather Bureau in the matter of meteorological observations over the oceans is the collection of information respecting their atmospheric disturbances, winds, temperature, densities, ice conditions; the prevailing weather of sailing and steamship routes; and the reduction and publication of this information in such form as will prove of the highest value to commerce and navigation.

The information in question is obtained entirely through a system of voluntary cooperation with the Bureau on the part of the navy and merchant marine of every maritime nationality on the globe, a specifically designated observer aboard each cooperating vessel being under instructions from the master to furnish the Bureau with certain daily observations; the Bureau, in return, furnishing the master of such vessel and the observer with a copy of such publications as may be founded on the observations in question.

Instructions to the local offices of the Weather Bureau interested in

the conduct of the work were issued early in the year. These offices are at present as follows:

Portland, Me.	New Orleans, La.	Tampa, Fla.
Boston, Mass.	Galveston, Tex.	Seattle, Wash.
New York, N. Y.	Tacoma, Wash.	Portland, Oreg.
Philadelphia, Pa.	Wilmington, N. C.	San Francisco, Cal.
Baltimore, Md.	Charleston, S. C.	San Diego, Cal.
Norfolk, Va.	Jacksonville, Fla.	Honolulu, H. I.
Pensacola, Fla.	Savannah, Ga.	
Mobile, Ala.	Key West, Fla.	

The number of weather reports received during the year was 8,160, and their geographical distribution covering the period July, 1905, to June, 1906, inclusive, was as follows: North Atlantic Ocean, 6,555; South Atlantic Ocean, 441; North Pacific Ocean, 1,030; South Pacific Ocean, 327; Indian Ocean, 110.

#### MOUNT WEATHER RESEARCH OBSERVATORY.

The meteorological work of a first order station has been maintained throughout the year, and telegraphic reports were transmitted to the central office in Washington daily at 8 a. m. and 8 p. m.

Work on the Physical Laboratory was resumed in July and satisfactory progress was made during the summer and fall of 1905. The building will probably be completed early in 1907.

In the preparation for kite and balloon work a number of important instruments have been installed and made ready for systematic work. Among these may be mentioned: (1) The electrolyzer, for the manufacture of the hydrogen gas employed in the kite balloon and the small rubber balloons; (2) the apparatus for the manufacture of liquid air, employed in testing thermometers at very low temperatures; (3) the apparatus used in testing the barometers, thermometers, and meteorographs employed in connection with the kites and balloons. A medium-sized power kite reel was installed in the revolving kite house early in the year, and experimental kiteflying was begun in September of 1905. During the year the stock of meteorographs, of kites, and of kite wire was materially increased; the instrumental equipment now includes eight different styles of kite—balloon meteorographs, comprising English, German, and French designs, in addition to the Marvin type heretofore used in the kite work of the Bureau, and the new Fergusson pattern used at the Blue Hill Observatory.

In April, 1906, systematic cooperation was begun in connection with the work of the International Commission of Aerial Research by flying kites on prearranged term days, and this work is being regularly maintained.

The interior finishings of the magnetic observatory buildings, the erection of the piers, and the installation of the magnetic instruments were completed during the year.

The instruments for absolute observations, except the declinometer and some auxiliary apparatus, were received and set up before January 1, 1906. The remaining absolute instruments were received and put in place by the end of May, and routine observations were established at the end of the fiscal year.

The Eschenhagen magnetographs were set up in the basement of the absolute observatory in December, 1905, and have given a satisfactory record of the magnetic elements since that time. The Wild

magnetographs were received and installed by the first of June, and were being adjusted at the close of the fiscal year.

A gas plant for heating and illuminating the magnetic observatories was put in during the winter and has given satisfactory service since then.

Plans were prepared for an additional office and dwelling for the director of upper-air research, and work on this building was begun July 1, 1906.

#### SOLAR RADIATION.

From May 1 to November 27, 1905, Mr. H. H. Kimball was detailed for duty at the Astrophysical Observatory of the Smithsonian Institution. Here, through the courtesy of the late Prof. S. P. Langley, in addition to maintaining solar-radiation observations with the Angstrom pyrhelimeter, and measurements of the maximum polarization of skylight with the Pickering polarimeter, comparisons were made between this pyrhelimeter and the actinometers in use at the observatory, and valuable experience was obtained in the use of the bolometer and in the reduction of actinometric and bolometric observations. As a result of this experience the system under which solar-radiation observations have been maintained since April, 1903, has been materially modified.

#### SPANISH-ALGERIAN ECLIPSE EXPEDITION.

In compliance with the request of Rear-Admiral C. M. Chester, U. S. Navy, Superintendent of the Naval Observatory, for the Weather Bureau to cooperate in the expedition to observe the total eclipse of the sun, August 30, 1905, the meteorological work of the expedition was assigned to Prof. Frank H. Bigelow, with Dr. Stanislaw Hanzlik as his principal assistant. Other assistants were appointed by Rear-Admiral Chester from the naval officers or men, and three primary stations were equipped and operated, viz, at Daroca and Porto Coeli, in Spain, and Guelma, in Algeria. Secondary stations were established at Castellon, Tortosa, Zaragoza, and Guadalajara, in Spain, and at Bona, in Algeria. The Spanish officials extended every possible courtesy in facilitating the operations of the expedition. An extensive series of observations was secured during August, 1905, including the usual meteorological elements, the coefficient of dissipation, the ionization contents, and the potential gradient of the atmospheric electricity, the solar radiation and the polarization.

On the voyage between Hampton Roads and Gibraltar several kite ascensions were made over the ocean, and numerous electrical and polarization observations were secured.

A report of the results of the meteorological work of the expedition has been prepared by Professor Bigelow and transmitted to the Navy Department for publication with the report of the astronomical researches.

#### LIBRARY.

It is the aim of the library to maintain a collection of standard works of reference and of technical books on meteorology and allied sciences for the use of Weather Bureau officials in Washington and elsewhere; also, to collect and preserve printed climatological data from all parts of the world. While many general reference books are of necessity



duplicated in other government libraries, this is not the case with respect to purely meteorological and climatological works. Even the Library of Congress refers readers to the Weather Bureau library when extensive research along these lines is to be made.

Although many important books and publications can only be obtained by purchase, by far the greater number are received in exchange for Weather Bureau publications, or as gifts from authors and publishers. During the last year 416 were obtained by gift and exchange, while only 116 were purchased.

The work of extending the exchange system so as to include as nearly as possible all climatological data published throughout the world is now being systematically carried on. This literature will in time be fully catalogued and made accessible to students. For the present special attention is being paid to those regions of the world which have been least explored by meteorologists, and for which, therefore, such meteorological data as exist are in the greatest need of being collected and preserved. This climatological work is the special field of Mr. Talman, assistant librarian, who utilizes the rich resources of the library in preparing a monthly international review of climatology for the *Monthly Weather Review*. Such work is undertaken primarily in response to the demands constantly made upon our library for information regarding meteorology of foreign lands, but it is also in accord with the spirit of international investigation which now prevails generally among progressive meteorologists.

Lists of the more important books added to the library, and of important papers relating to meteorology that have appeared in current periodicals, have been prepared for publication in each number of the *Monthly Weather Review*.

#### METEOROLOGICAL RECORDS.

The Division of Meteorological Records and the Barometry Section have been united during the year and placed in charge of Prof. Frank H. Bigelow. The care of the manuscript records of the meteorological observations made throughout the service, the checking of the computations, the preparation of the tabular data for the *Monthly Weather Review* and the annual report, and the supplying of the public with information, including the Federal Departments and Bureaus, State, county, and city officials, civil engineers, and many individuals, are in charge of this division. The discussion of the records and the compiling of data for scientific purposes, especially the relations of solar physics to meteorology, are carried on as far as practicable. Special attention is given at present to the temperature data, and tables of station normals based upon thirty-three years of observations reduced to a homogeneous system, together with the annual and monthly variations, are being prepared. At the same time, similar data for the vapor pressure are being computed. These works, when finished, together with the barometry of the United States already published, will constitute a fundamental system of data upon which scientific studies of the variable climatic conditions may properly be based.

#### THE TEACHING OF METEOROLOGY.

The officials of the Weather Bureau have had their attention forcibly drawn to the teaching of meteorology by the increased recogni-

tion of that science as a branch of study appropriate to high schools, normal schools, colleges, and universities. In answer to circular letters sent out by Professor Abbe it would appear that elementary climatology, considered as a part of geography, is taught in about 1,000 graded schools. Elementary climatology and meteorology are taught in connection with geology in about 7,000 high schools, or seven-eighths of the whole number that are catalogued by the Bureau of Education.

Specific courses in meteorology or climatology are given in about 140 out of 177 public normal schools, although in some of these the subject is taught in connection with physical geography. Out of 311 colleges and universities from which direct replies have been received, 59 state that they have specific courses in meteorology, 133 teach this in connection with some other subject, and 119 pay no attention to it. The corresponding percentages are 19, 43, and 38, and probably the replies from other colleges will not alter these ratios very much. In fully one-half of these institutions, from the lower schools to the higher universities, some form of laboratory method is pursued—that is to say, students are required to make personal observations, experiments, and deductions. They study the daily weather map and develop habits of individual thought. In a matter so complex as the weather, no text-books can replace the daily map, personal observations, and independent study.

In addition to the popular work of the high schools and colleges, a higher class of work has been carried out by the scientific schools and universities. This special technical instruction is divided into two parts—that which is done by the scientific faculty as such and that which is done by Weather Bureau officials temporarily appointed as instructors, who sometimes do this educational work without extra compensation from the colleges. There are 19 of the latter and about 50 of the former.

Effort is being made to correlate and reduce to a uniform system the standard of instruction to be given at these institutions, so that, at least in some cases, these scientific schools may prepare men for the highest work that is required of a Weather Bureau official.

#### INSTRUMENTAL EQUIPMENT.

Systematic efforts were continued during the year to bring as many as possible of the long-established telegraphic-reporting stations up to the uniform standard of equipment as now furnished new stations, and the instrumental outfits at Grand Haven, Mich.; Mobile, Ala.; Red Bluff, Cal.; North Platte, Nebr.; Baker City, Oreg.; Winnemucca, Nev., and Abilene, Tex., were completed. It is hoped to finish this work during the next fiscal year, as there still remain in the service only a few stations where the improved automatic self-recording instruments are required for climatological or local interests.

New stations at Anniston, Ala.; Thomasville, Ga.; Del Rio, Tex.; Iola, Kans.; Bentonville, Ark.; Burlington, Vt.; Tonopah, Nev., and Canton, N. Y., were completely equipped with new instruments, and a duplicate equipment was sent to San Jose and San Francisco, Cal., the equipments for the two last-named stations being required on account of the total destruction of the instruments formerly in use there by the disastrous earthquake and fire of April 18, 1906. These

two stations were completely wiped out of existence in a few hours, involving the loss of several thousand dollars' worth of instruments and apparatus, to say nothing of valuable records and data that neither time nor money can replace.

#### INVESTIGATION OF FROST CONDITIONS IN CRANBERRY REGIONS.

Prof. Henry J. Cox, in charge of the north-central forecast district, with headquarters at Chicago, was authorized to take up a carefully studied project of work in the cranberry marshes of Wisconsin, with a view to obtaining more precise and detailed information concerning the meteorological and soil conditions in that section which shortly precede, accompany, and follow frosts than is obtainable from the ordinary Weather Bureau observations made at relatively widely separated stations. The definite object in view is to establish a scientific basis for more accurate frost prediction for those sections of the country devoted to this special industry.

The equipment of instruments comprized soil thermometers and thermographs, Assmann's aspiration psychrometers, and ordinary thermographs for recording air temperatures, together with other standard instruments of the usual types. Owing to delays in the delivery of the important instruments purchased in European markets, observations of the late spring frosts could not be made, and on this account the work will no doubt require to be extended longer than was originally contemplated.

#### RIVER-STAGE INDICATOR.

The vast importance which attaches, in flood seasons, to the stages of large navigable rivers makes an instrument that will indicate at all times, in the local offices of the Weather Bureau at stations situated on these rivers, the exact stage of the water a practical necessity. Heretofore devices of this character have been debarred, not only because of the considerable expense involved in their installation, but also because a suitable form of apparatus at reasonable cost was not on the market. During the past year, however, a form of instrument developed by the official in charge of the instrument division was perfected and promises to prove very satisfactory. One was installed at Portland, Oreg., and recently steps have been taken to place a similar instrument at Pittsburg, Pa.

By the aid of this instrument the official needs only to look at the dial indicator on the wall of his office, from which the stage of the river at that station is quite easily read. The instrument also indicates whether the river is rising or falling.

#### EARTHQUAKES AND THE RELATIONS OF THE WEATHER BUREAU TO THEIR REGISTRATION.

Attention has been drawn to the scientific observation of earthquakes by the calamity that befell San Francisco on the 18th of April last, and it seems proper at this point to recall briefly the part taken by the Weather Bureau in this direction. As early as 1886, shortly after the great Charleston earthquake, a simple form of instrument was installed at Washington, D. C. This instrument was able to show, by the stopping of a clock, only the time of beginning of certain slight



disturbances. At that early date accurate seismographs were not in existence except, perhaps, a few imperfect forms developed by Ewing, Gray, and Milne in Japan. The removal in 1888-89 of the offices of the meteorological service to its present location resulted in an interruption of the seismic observations. A better instrument, but still of very simple form, was installed in 1893, and for many years was practically the only instrument for the purpose in the United States that was diligently maintained in continuous action. In the meantime, however, far more delicate and complete instruments had been developed in Japan and elsewhere, and one of the best modern types, making a complete record of the horizontal motion of the ground, was installed at the Weather Bureau in February, 1903.

A number of distant earthquakes were recorded on this instrument, which only shortly before the San Francisco disturbance was reinstalled in a much improved fashion. The great earthquake was admirably recorded at the Weather Bureau, the motion of the pen being so violent as to be carried off the sheet for a portion of the time, causing a loss of record for about three minutes, after which, as the violence of the motion subsided, the pen resumed its record. Notwithstanding this, however, no one could feel the motion in Washington; but we see from this how very sensitive to earth vibrations these instruments are. No other instruments of this character are maintained by the Weather Bureau at the present time, and it seems proper at this place to call attention, very briefly, to certain important considerations bearing upon the question of seismic observations.

It is now well known that the whole crust of the earth is very frequently shaken by earthquakes, and that several thousand disturbances, great and small, occur every year. A complex and difficult geophysical problem is presented in these phenomena, which are now just beginning to be observed and studied in a systematic manner.

After several preliminary conferences an international bureau of seismology was finally established within the current year, which has been joined by nearly all the principal civilized nations of the world. The part to be taken by the United States Government in this important seismological work is at present entirely unorganized and ill defined, but I desire at this time to point out that the Weather Bureau is prepared and qualified to contribute to this work in an effective manner with but little additional expense. It has numerous stations widely distributed and manned by specially trained and skillful observers. It also employs means for collecting and distributing information that can hardly be surpassed. These circumstances render it proper, I think, for the Weather Bureau to undertake the systematic registration of earthquakes by means of instruments of the highest type at a small number of its stations. A considerable number of stations is not necessary for the general international work; ten or fifteen will probably answer every requirement. Places at which Weather Bureau buildings have been erected will afford favorable conditions for the installation of seismographs.

#### TELEGRAPH, TELEPHONE, AND CABLE LINES.

An important addition to the system of Weather Bureau telephone lines and cables on the Great Lakes was made on September 12, 1905, by the laying of a submarine cable from Charlevoix, Mich., to St. James, Beaver Island, Mich., a distance of  $33\frac{1}{2}$  miles. A connecting

land line 2 miles long was built during June, 1906, from St. James to Church Hill, on the same island. Aside from its main object—the transmission of storm-warning messages to the displaymen at St. James and Church Hill—the cable connection with the mainland is of no little importance to the business interests of Beaver Island.

The telephone line from Grand Marais to Vermilion, Mich., was extended to Whitefish Point, a distance of 10 miles. The entire section is jointly owned and operated by the Weather Bureau and the Life-Saving Service, and affords the sole communication for a chain of storm-warning and life-saving stations on eastern Lake Superior.

The other sections of the Weather Bureau telegraph and telephone lines on the lake and sea coasts were maintained in efficient working order, excepting only the line from San Francisco to Point Reyes Light, Cal., which was partly destroyed by the great earthquake of April 18, 1906.

The receipts from private messages transmitted over Weather Bureau lines amounted to \$3,036.84. In addition, \$2,101.92 was collected for connecting commercial lines.

#### REPORTS OF PASSING VESSELS.

A total of 26,818 vessels of all rigs was reported from the several Weather Bureau stations on the Atlantic, the Pacific, and the Gulf coasts direct to the owners, agents, and maritime associations concerned. Special reports of shipwrecks and other marine casualties were made when opportunity offered.

#### EXAMINATION AND PROMOTION.

Examinations serve two useful purposes: (1) They stimulate systematic study on the part of the younger men; (2) and they afford an index to educational attainments that is of assistance in selecting men for promotion.

In order that they may serve as a mental stimulus, they must be of such character that they can be passed by a majority of those who undertake them, since repeated failures are a discouragement. On the other hand, in order that they may be useful in selecting men for promotion to important positions, they must be of such character that they will clearly indicate the ability of the person examined. It is to the interest of all concerned that an examination should call attention to deficiencies in education where such exist, since by determined effort such deficiencies can in almost every case be overcome.

It having become evident that examinations heretofore given in English grammar were tests of technical knowledge of the construction of the language rather than ability to use it correctly, the supervising examiner was instructed to include in this examination, in addition to exercises in false syntax, an essay of not less than 500 words, and also to mark the grammatical construction of the answers to the questions in elementary meteorology. The essays thus far graded indicate a very general defect in the style of a majority of the persons examined, in the following respects: (1) The frequent repetition of words; (2) the use of unnecessary words and phrases; (3) faulty arrangement of the parts of a sentence, so that in some cases the meaning conveyed is directly opposite to that which was intended; (4) bad punctuation, long paragraphs, containing several independent ideas, sometimes being written as a single sentence. In general,

faulty construction and bad style are more common than glaring grammatical errors. Emphasis is laid upon these facts because it is necessary for assistant observers to write good English before they are fit to take charge of stations and prepare reports for publication.

The following table gives the number of examination papers marked during the year:

Subject.	Date of examination.					Number of employees examined.		
	1905.			1906.		Total.	Passed.	Failed.
	June.	Sept.	Dec.	Mar.	June.			
English grammar .....	6	5	7	31	18	67	52	15
Arithmetic .....	6	4	6	10	7	33	26	7
Elementary meteorology .....	5	6	6	9	4	30	24	6
Algebra .....	3	4	7	9	4	27	23	4
Physics .....	3	3	5	5	8	24	20	4
Trigonometry .....	5	5	2	5	8	25	20	5
Astronomy .....	4	2	2	4	3	15	14	1
Plant physiology .....	1	.....	5	3	5	14	14	0
Advanced meteorology .....	1	.....	3	5	2	11	11	0
Total .....	34	29	43	81	59	246	204	42

<sup>a</sup>One thrown out because of dishonesty in connection with the examination.

#### OBSERVATORY BUILDINGS.

The Weather Bureau buildings referred to in my last report as being in course of construction at Bentonville, Ark., Burlington, Vt., North Platte, Nebr., Oklahoma, Okla., Springfield, Ill., and a physical laboratory at Mount Weather, Va., have been completed and are now occupied, with the exception of the last, which will probably be completed before July 1, 1907.

The following is a complete list of the buildings owned by the Weather Bureau, with the cost of the land and buildings in each case:

#### *Buildings owned by the Weather Bureau.*

Location.	Value of lot.	Value of buildings.	Total value.
Amarillo, Tex. ....	\$1,255.00	\$6,503.00	\$7,758.00
Atlantic City, N. J. ....	(a)	6,000.00	6,000.00
Bentonville, Ark. ....	570.40	5,144.50	5,714.90
Bismarck, N. Dak. ....	(a)	10,000.00	10,000.00
Block Island, R. I. ....	1,100.00	7,700.00	8,800.00
Burlington, Vt. ....	(b)	10,505.95	10,505.95
Cape Henry, Va. ....	(a)	9,104.25	9,104.25
Columbia, S. C. ....	3,799.00	9,170.00	12,939.00
Devil's Lake, N. Dak. ....	2,300.00	8,000.00	10,300.00
Duluth, Minn. ....	2,100.00	7,900.00	10,000.00
Hatteras, N. C. ....	125.00	4,875.00	5,000.00
Havre, Mont. ....	1,850.00	5,700.00	7,550.00
Jupiter, Fla. ....	(a)	6,094.95	6,094.95
Key West, Fla. ....	2,020.00	7,994.75	10,014.75
Kittyhawk, N. C. ....	(a)	1,616.00	1,616.00
Modena, Utah. ....	(a)	4,346.00	4,346.00
Mount Weather, Va.: ..			
Observatory building .....	2,000.00	18,000.00	20,000.00
Power house and balloon building .....	650.00	8,000.00	8,650.00
Absolute building .....	(a)	6,500.00	6,500.00
Variation building .....	(a)	8,000.00	8,000.00
Kite shelter .....	(a)	3,000.00	3,000.00
Stable .....	(a)	2,000.00	2,000.00
Barn .....	(a)	900.00	900.00
Cottage for workmen .....	(a)	1,300.00	1,300.00
Mount Washington, N. H. ....	(c)	300.00	300.00
Nantucket, Mass. ....	1,236.50	3,968.00	5,204.50

<sup>a</sup> Government reservation.

<sup>b</sup> Donated by University of Vermont.

<sup>c</sup> Leased.



*Buildings owned by the Weather Bureau—Continued.*

Location.	Value of lot.	Value of buildings.	Total value.
Narragansett Pier, R. I. ....	\$4,100.00	\$8,000.00	\$12,100.00
North Head, Wash. ....	(a)	4,000.00	4,000.00
North Platte, Nebr. ....	(b)	3,818.50	3,818.50
Oklahoma, Okla. ....	(c)	10,886.35	10,886.35
Peoria, Ill. ....	54.00	7,915.00	7,969.00
Point Reyes Light, Cal. ....	(a)	3,000.00	3,000.00
Port Crescent, Wash. ....	82.00	1,000.00	1,082.00
Sand Key, Fla. ....	(a)	5,593.00	5,593.00
Sault Ste. Marie, Mich. ....	(a)	3,000.00	3,000.00
Southeast Farallon, Cal. ....	(a)	5,211.22	5,211.22
Springfield, Ill. ....	(a)	10,602.70	10,602.70
Tatoosh Island, Wash. ....	(a)	5,000.00	5,000.00
Washington, D. C. ....	25,000.00	150,000.00	175,000.00
Yellowstone Park, Wyo. ....	(a)	11,500.00	11,500.00
Yuma, Ariz. ....	(a)	1,500.00	1,500.00
Total .....	48,241.90	393,649.17	441,891.07

a Government reservation.

c Donated by Epworth University.

b Old building bought.

It has been found not only economical to the Government but advantageous to the prompt and efficient administration of the Weather Service, at many places, to rent small buildings which provide office rooms and living quarters for the observer. These buildings are usually cottages, and only those having grounds large enough to insure a satisfactory exposure for meteorological instruments are selected. When the observer lives in the same building in which the automatic instruments are installed it insures their having constant attention, and the public can obtain at any time forecasts and information in regard to storms, cold waves, etc. The following list shows the places at which such buildings are rented by the Weather Bureau, the annual rent paid, and the items included in the lease. In nearly every instance the amount of rent paid is less than would be that of office rooms in business blocks. This plan results in further economy to the Government, because the salary paid to an official who is provided with living quarters is less than would be given him if such quarters were not furnished.

*Rented buildings occupied wholly by the Weather Bureau.*

Station.	Annual rent.	Other items included.
Alpena, Mich. ....	\$650.00	Heat, light, water.
Anniston, Ala. ....	475.00	
Charles City, Iowa. ....	420.00	Do.
Del Rio, Tex. ....	444.00	Do.
Durango, Colo. ....	440.00	Heat, cleaner, light, water.
East Clallam, Wash. ....	120.00	Water.
Flagstaff, Ariz. ....	300.00	
Helena, Mont. ....	504.00	Heat, water.
Independence, Cal. ....	432.00	Heat, light, water.
Kalispel, Mont. ....	360.00	
Lewiston, Idaho. ....	540.00	
Manteo, N. C. ....	144.00	
Moorhead, Minn. ....	600.00	Do.
Mount Tamalpais, Cal. ....	420.00	Do.
Pysht, Wash. ....	144.00	Water.
Roseburg, Oreg. ....	550.00	Heat, light, water.
Roswell, N. Mex. ....	720.00	Heat, cleaner, light.
Santa Fe, N. Mex. ....	360.00	
Santo Domingo, West Indies. ....	480.00	
Thomasville, Ga. ....	420.00	
Tonopah, Nev. ....	1,200.00	
Twin, Wash. ....	100.00	
Williston, N. Dak. ....	450.00	Heat, cleaner, light, water.
Winnemucca, Nev. ....	360.00	Heat, light, water.
Iola, Kans. ....	468.00	Do.

*Stations at which observers' quarters are furnished by the Government separate from offices.*

Station.	Annual rent.	
	Office.	Residence.
Bridgetown, Barbados.....	\$240.00	\$240.00
Honolulu, H. I.....	480.00	540.00

During the fiscal year beginning July 1, 1906, observatory buildings will be constructed at Anniston, Ala.; Birmingham, Ala.; Charles City, Iowa; Iola, Kans.; Mount Weather, Va., cottage and office building; Mount Weather, Va., physical laboratory building;<sup>a</sup> Sandy Hook, N. J.; Sheridan, Wyo.

It is not practicable, however, to state the cost of the grounds and buildings at these places, because, in most instances, the purchase of the ground has not been consummated and the building contracts have not been let.

#### CHANGES IN THE FORCE OF THE BUREAU.

##### CLASSIFIED SERVICE.

**APPOINTMENTS.**—One hundred and thirteen permanent appointments were made during the fiscal year—by certification for probationary period, 100 (of which number 49 were assistant observers, at \$720 per annum), at \$360 to \$1,250 per annum; by transfer from other bureaus, 4, at \$1,200 to \$2,000; by reinstatement, 8, at \$360 to \$1,000, and by Executive order, 1, at \$3,000 per annum.

**TEMPORARY AND EMERGENCY APPOINTMENTS.**—There were 37 temporary appointments for periods of less than ninety days, at \$360 to \$1,000, mostly station messenger boys, at \$360, whose appointments were made pending the action of the Civil Service Commission to secure eligibles, and 8 emergency appointments, for one to thirty day periods, at \$450 to \$1,000.

All temporary and emergency appointments were made under the authority of the Civil Service Commission.

The total number of appointments of all kinds made during the year was 158.

**PROMOTIONS.**—One hundred and eighty-three promotions were made by advancement to the next higher grade.

**REDUCTIONS.**—Necessitated by the public needs or due to change of station assignment requested by employee, 15; because of decreased efficiency, 5; to eliminate the \$1,500 and \$1,300 grades, 22; for neglect of duty, errors, etc., 13; for speculating, in violation of station regulations, 1; for culpable negligence and irregularity in filing practice forecasts, 1; because of allowances of quarters, fuel, and light, 5; total reductions for the year, 62.

**RESIGNATIONS.**—Fifty-two voluntary separations occurred, of which 11 were made to enable the employees to accept positions in other Government bureaus. Sixteen resignations were required—1 for refusing station assignment, 1 because of conflicting public and private interests, 3 for incompetency, 6 for unsatisfactory services, 1 for unsatisfactory conduct and services, 3 for unsatisfactory conduct, and 1 for physical disability; total separations by resignation during the year, 68.

<sup>a</sup>One-half constructed previous year.

REMOVALS.—For neglect of duty and insubordination, 1; for unsatisfactory services, 2; for shiftless habits and personal misconduct, 1; for absence without authority, 2; for flagrant disobedience of orders, 1; because of insanity, 1; for disobedience of instructions and falsification of records, 1; total, 9.

DROPPED FROM ROLLS AT TERMINATION OF PROBATIONARY PERIOD.—Two probationers were refused absolute appointment because of unsatisfactory services.

DEATHS.—Total, 6.

#### UNCLASSIFIED SERVICE.

APPOINTMENTS.—Appointments to the unclassified service numbered 10, the salaries ranging from \$240 to \$480 per annum, as follows: For duty at Washington, D. C., 3 (2 through the board of labor employment and 1 for an emergency period of less than one month); for duty outside the District of Columbia, 7 (1 station agent, 3 student assistants, 3 road laborers).

PROMOTIONS.—Four unclassified employees were promoted during the year, each to the next higher grade, the salaries ranging from \$360 to \$720 per annum.

RESIGNATIONS.—There was one (voluntary) resignation.

REDUCTIONS.—One unclassified employee was reduced for using extraneous influence to secure change of station assignment.

DISCHARGES.—Three laborers were discharged as commissioned employees and reemployed as per diem men.

#### ABSENCES DURING THE CALENDAR YEAR 1905.

STATION.—The average absence with pay of station employees (99 per cent being males) during the calendar year 1905 was 1.4 days on account of sickness and 9.1 days on account of annual leave.

WASHINGTON, D. C.—The average absence with pay of employees at Washington, D. C. (officials, clerks, mechanics, messengers, and laborers), during the same period was: Males, 3.9 days on account of sickness and 26.1 days on account of annual leave; females, 2.8 days on account of sickness and 27.8 days on account of annual leave.

The general average of the entire service, station and Washington combined, was 2.1 days on account of sickness and 13.8 days on account of annual leave.

#### STATISTICS OF THE SERVICE.

The following tables show the numerical strength of the Bureau and the highest and lowest salaries paid in the classified and unclassified grades:

##### *Numerical strength of the Weather Bureau, June 30, 1906.*

At Washington, D. C.:		
Classified .....	172	
Unclassified .....	11	
		183
Outside of Washington, D. C.:		
Classified .....	496	
Unclassified .....	17	
		513
Total commissioned employees .....		<sup>a</sup> 696

<sup>a</sup> This total represents an increase of 16 over the number reported June 30, 1905, and is exclusive of 16 employees on furlough for three months or more on June 30, 1906.



## Additional employees outside of Washington, D. C.:

Storm-warning displaymen.....	164
River observers.....	340
Cotton-region observers.....	144
Corn and wheat region observers.....	133
Rainfall observers.....	107
Sugar and rice region observers.....	9

Total noncommissioned employees ..... 897

Total paid employees..... <sup>a</sup> 1,593

## Persons serving without compensation (except through the distribution of Government publications):

Cooperative observers.....	3,683
Cooperative storm-warning displaymen.....	<sup>b</sup> 71
Weather correspondents.....	<sup>c</sup> 4,841

Total numerical strength..... 8,595

*Distribution of the commissioned force, June 30, 1906.*In Washington, D. C.: No. of employees.

Accounts Division.....	12
Climatological Division.....	7
Editor, Monthly Weather Review.....	3
Executive branch.....	<sup>d</sup> 17
Forecast Division (including River and Flood Service).....	13
Division of Ocean Meteorology.....	7
Instrument Division.....	10
Library.....	3
Division of Meteorological Records.....	17
Miscellaneous Mechanical Work.....	5
Publications Division.....	43
Supplies Division.....	<sup>e</sup> 10
Telegraph Division.....	11
Captain of the Watch (under direction of the Chief Clerk).....	25

Total..... 183

## Outside of Washington, D. C.:

64 stations with 1 employee.....	64
50 stations with 2 employees.....	100
36 stations with 3 employees.....	108
19 stations with 4 employees.....	76
12 stations with 5 employees.....	60
6 stations with 6 employees.....	36
4 stations with 7 employees.....	28
3 stations with 8 employees.....	24
1 station with 9 employees.....	9
2 stations with 11 employees.....	22

197 stations..... <sup>f</sup> 527

<sup>a</sup> This total embraces all paid employees in the Bureau on June 30, 1906, including the Chief of Bureau, but excluding employees on furlough for three months or more.

<sup>b</sup> Twenty of these cooperative displaymen are employed in other branches of the Government service.

<sup>c</sup> About 75 per cent of this number also serve as cooperative observers. This decrease from the report of 1905 is due to dispensing with the services of a large number of weather crop correspondents, rendered unnecessary by the elimination of the crop feature from the Weather Bulletin.

<sup>d</sup> Two men devote half their time elsewhere.

<sup>e</sup> Plus one-half the time of one man.

<sup>f</sup> This number represents the *normal* regular station force. On June 30, 1906, there were actually on duty but 513 employees.

In addition to the above, there are seven one-man stations in the West Indies, in charge of noncommissioned employees (generally agents of cable companies).

*Salaries paid in the classified and unclassified grades.*

Grades.	June 30, 1906.	
	Station.	Washington, D. C.
Classified:		
Highest salary .....	\$3,000	\$5,000
Lowest salary .....	360	450
Average salary .....	986	1,207
Unclassified:		
Highest salary .....	720	720
Lowest salary .....	300	240
Average salary .....	384	492

The average salary for all (station and Washington, including the Chief of Bureau) is \$1,028.

The foregoing table of salaries does not include employees on duty at substations (storm-warning displaymen, river observers, etc.) whose compensation ranges from \$5 to \$20 per month, and whose tour of service averages less than one hour a day; and it does not include 7 station agents in the West Indies, each averaging about \$25 a month.

#### RECOMMENDATIONS.

It is recommended that four additional Weather Bureau stations be created and that for this purpose \$10,000 be added to the fund "Salaries, Weather Bureau," and also that \$10,000 be added to the fund "General Expenses, Weather Bureau," with \$5,000 additional to provide for the gradual increase of telegraphic expense at the existing stations of the Bureau. Two additional clerks are recommended for duty at the central office to perform the additional work entailed upon the Bureau by the creation of new stations and the increasing demands for additional reports.

An appropriation of \$22,000 is also recommended for the purchase and the laying of a cable to connect Devils Island, Minnesota, with the mainland.





## REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF ANIMAL INDUSTRY,  
*Washington, D. C., September 27, 1906.*

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1906, together with plans and recommendations for the future.

Respectfully,

A. D. MELVIN,  
*Chief of Bureau.*

HON. JAMES WILSON, *Secretary.*

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### INTRODUCTION.

For the first two and a half months of the fiscal year covered by this report the work of the Bureau was under the direction of Dr. D. E. Salmon as chief, and for the remainder of the period it has been in charge of the writer. Doctor Salmon, after continuous service in the position of chief for more than twenty-one years, beginning with the organization of the Bureau in 1884, resigned that position early in September, 1905, and his resignation was accepted by you, to take effect November 1. The writer, who was assistant chief at the time of Doctor Salmon's resignation, was in charge of the Bureau work as acting chief from the middle of September (when Doctor Salmon relinquished the active management in order to complete some special work before his retirement), and was appointed chief on December 1.

The organization of the Bureau at the beginning of the fiscal year, as for some time before, consisted of ten divisions, or offices, as follows: The Inspection Division, in charge of the meat inspection, the inspection of animals for interstate shipment and for export, the inspection and supervision of vessels carrying export animals, and the eradication of contagious diseases; the Quarantine Division, charged with the inspection and quarantine of imported animals and with keeping the accounts of the Bureau; the scientific laboratories, comprizing the Pathological, Biochemic, and Zoological Divisions; and the Dairy Division, the Experiment Station, the Animal Husbandry Office, the Editorial Office, and the Library, each carrying on work of the character indicated by its title.

For the future some of the assignments of work have been slightly changed. The inspection of animals for export as well as of those

imported and the inspection and supervision of vessels carrying export animals has been placed under the Quarantine Division, and that division has been relieved of the accounting work, which has been transferred to the newly organized Office of Accounts. The work of the Inspection Division has been subdivided, the meat inspection being placed in one section and the inspection of animals for interstate shipment and the eradication of contagious diseases in another. The work of the Dairy Division has been arranged in a more orderly manner by subdivision into several sections.

On January 6, 1906, the Bureau sustained the loss by death of its editor, Mr. George Fayette Thompson, who, in addition to his editorial duties, had charge of the Bureau's work relating to Angora and milch goats. Since his death the latter portion of his work has been transferred to the Animal Husbandry Office.

The total appropriations for the Bureau's work for the fiscal year amounted to \$1,603,000. On July 1, 1906, there were 1,455 employees on the rolls of the Bureau.

### THE MEAT INSPECTION.

The meat inspection, as in previous years, has been the largest branch of the Bureau's work. In this service more than half the members of the Bureau force are engaged and more than half the appropriation for the year was expended.

As the conditions at the Chicago stock yards and packing houses have been so prominently before the public during recent months, it may be well to point out certain facts regarding the meat-inspection service as conducted by the Bureau.

Until the passage of the new meat-inspection law on the last day of the fiscal year (June 30, 1906), the inspection was carried on under the act of March 3, 1891, as amended by the act of March 2, 1895. That law provided for—

1. The inspection of all live cattle which were intended for export or whose carcasses or products were intended for export.

2. (a) The mandatory ante-mortem inspection of cattle, sheep, and hogs which were subjects of interstate commerce and which were about to be slaughtered at slaughterhouses, canning, salting, packing, or rendering establishments in any State or Territory, the carcasses or products of which were to be transported and sold for human consumption in any other State or Territory or the District of Columbia.

- (b) The additional permissive post-mortem examination of carcasses of all cattle, sheep, and hogs about to be prepared for human consumption at any slaughterhouse, canning, salting, packing, or rendering establishment in any State or Territory or the District of Columbia and which were the subjects of interstate commerce.

In other words, the ante-mortem inspection was made mandatory, while the post-mortem examination was only discretionary.

Some of the defects and limitations of this law should be noted to give an idea of the disadvantages under which the inspection has been conducted. In the first place, the law required the ante-mortem inspection of all cattle, sheep, and swine slaughtered at certain classes of establishments the carcasses or products of which were to enter interstate commerce, but no specific provision was made for

funds with which to perform this work, and the annual appropriation has never been sufficient to enable the Bureau to cover all establishments carrying on an interstate business. Indeed, many establishments which applied for inspection had to be refused on account of lack of money to carry on the work.

While the law authorized the marking of meats and products which on inspection were found free from disease and wholesome, and prohibited the interstate shipment of meats and products found diseased and unwholesome, it made no provision and gave no authority for marking and rendering unfit for food purposes the diseased and unwholesome carcasses and products. As a matter of fact, however, it has long been the practice of the Bureau to require the destruction of all condemned carcasses and parts, though in case of the refusal of the proprietor to comply with such orders there was no remedy except to withdraw inspection.

It is very doubtful whether the law gave any authority for following up meats after they had once been inspected and passed immediately after slaughter, or for condemning any such meat which might afterwards become unwholesome or unclean before or during the process of canning or packing or before being placed on the market. But whether the law gave any such authority or not is a purely academic question, since the lack of funds made it impossible to extend the inspection to cover all the processes of curing, canning, packing, etc. No authority whatever to control the sanitation of the establishments or to prevent adulteration or the use of chemicals and preservatives was given by the law.

The inspection was therefore practically confined to the ante-mortem inspection of animals and the inspection of the carcasses immediately after slaughter. The meat found free from disease and otherwise wholesome at the time of this post-mortem inspection was properly marked, and that found diseased or unwholesome was destroyed. There is no question that this inspection was efficient as far as it went and that it went as far as the law and the limited appropriations allowed. In fact, as hereinbefore and hereinafter shown, the Bureau in its efforts to maintain an efficient inspection sometimes even went so far as to assume authority not conferred by law. In all the recent agitation the wholesomeness of the inspected fresh meat has not been seriously called into question. The disclosures of unsatisfactory conditions have related almost wholly to the canned and prepared meats, the use of preservatives, and the insanitary condition and methods of the packing establishments—matters over which the Bureau has had no control whatever under the law.

About the time I became Chief of the Bureau a number of articles criticising the inspection methods and the insanitary conditions at the Chicago stock yards and packing houses began to appear in certain medical journals and other publications. The subject was considered in the Department, and it was determined that the best way to get at the matter was to send a competent committee to Chicago to make an investigation. This was finally decided on about the middle of February, but on account of illness the committee was unable to get away until early in March. This committee, consisting of Dr. John R. Mohler, chief of the Pathological Division of this Bureau; Dr. B. P. Steddom, chief of the Inspection Division of



the Bureau, and Mr. George P. McCabe, Solicitor of the Department, made a thorough investigation and presented an exhaustive report under date of April 3. This report was promptly laid before you and by you transmitted to the President, and has been printed as a Congressional document.

Without waiting to send a committee to investigate and report, however, two orders regarding sanitation were issued in February. The Department Solicitor advised that, while such regulations were very necessary, the Department had no legal authority to enforce them; but it was decided to issue them nevertheless and to enforce them if possible. The first of these orders, issued February 8, 1906, to Bureau inspectors in charge of meat inspection, required that trucks and other receptacles used in handling tuberculous carcasses and parts thereof should not be used for any purposes other than handling condemned material and offal; also that all knives and other implements used, as well as the hands of the inspector, and the packing-house implements, should be washed in an antiseptic solution. Bichloride of mercury tablets were furnished for this purpose.

The other order regarding sanitation was as follows:

[Amendment No. 5 to B. A. I. Order No. 125.]

RULES AND REGULATIONS FOR THE INSPECTION OF LIVE STOCK AND THEIR PRODUCTS.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY.  
Washington, D. C., February 14, 1906.

*It is hereby ordered*, That section 4 of B. A. I. Order No. 125 be, and the same is hereby, amended by the addition of the following:

*Sanitation.*—(e) Official establishments shall be kept in a clean and sanitary condition. Ceilings, side walls, pillars, partitions, etc., shall, whenever practicable, be frequently whitewashed; where this is impracticable they shall, when necessary, be washed, scraped, or otherwise effectually cleaned; likewise all trucks and other receptacles used in moving, mixing, storing, or curing meat or meat products shall be frequently cleaned, and beef carriers or other employees who handle meat in contact with their clothing shall be required to keep such clothing in a sanitary condition. Separate, suitably ventilated, and otherwise sanitary toilet rooms and rooms for the reception of clothing of employees shall be provided and so located that the odors therefrom do not penetrate the rooms or compartments in which meat or meat products are prepared, cured, stored, packed, or otherwise handled; all such rooms or compartments (except the killing floors) shall be provided with cuspidors, and employees who expectorate shall be required to use them.

JAMES WILSON, *Secretary*.

On receipt of the committee's report showing the conditions which existed at Chicago I immediately wrote to the inspector in charge at that station directing him to take steps for the improvement of these conditions, and sent a traveling inspector to Chicago to assist in this work. On April 9 an order was issued to all inspectors in charge of meat inspection, stating that the report of the committee had revealed some conditions which must be improved at once, and directing them to see that all requirements of the meat-inspection regulations were rigidly enforced and to report any establishment which failed to comply with any part of the regulations. On May 22 the inspectors in charge of the principal stations were instructed to report whether amendment 5, regarding sanitation, was being complied with, and to



notify the proprietors of the establishments that lavatories must be installed, so that workmen could have no excuse for not keeping their hands clean, and that proprietors must see that employees did keep themselves clean. It was also ordered that meat must be raised from the floors, and that the practice of mixing meats upon the floors must be abandoned and suitable boxes or benches provided; also that wire netting and other covers for racks, vats, and boxes used for meats and meat products must be provided.

In order to correct an erroneous impression which has gained some currency, I wish to emphasize the fact that in all establishments where inspection is conducted by this Bureau all animals slaughtered are subjected to the same inspection, and all condemned carcasses and products are subjected to the same treatment, whether the meat is intended for local, interstate, or export trade, except in the case of the microscopic inspection of pork for trichinæ, this particular inspection being applied only to pork intended for export to a few countries requiring such inspection. This microscopic inspection is in addition to the regular inspection which is applied to all carcasses.

The weak points and the limitations of the laws under which the meat inspection has heretofore been conducted have long been realized, and several times in the past recommendations have been made by the Secretary of Agriculture and the Chief of the Bureau for the enactment of new laws and the increase of appropriations in order to extend the inspection and improve its efficiency. On two or three occasions bills to remedy some of the defects in the law have been introduced in Congress, but they failed of passage.

The new law of June 30, 1906, commonly known as the meat-inspection amendment to the agricultural appropriation act, is appended to this report. This law greatly enlarges the powers of the Secretary of Agriculture and makes a permanent annual appropriation of \$3,000,000 to pay the cost of meat inspection. With the additional authority and money thus granted the service will be greatly extended and strengthened. It is expected to extend the inspection as rapidly as possible to all establishments which are engaged in interstate or foreign business and come within the law, and to apply the inspection not only to the live animals before slaughter and to the carcasses immediately after slaughter, but afterwards to the meats and meat food products in all the stages and processes of preparation, curing, canning, etc.; also to require sanitary equipment, conditions, and methods; to prevent the use of harmful chemicals and preservatives and of misleading labels, and to regulate the transportation of meat in interstate and foreign commerce. Regulations covering these various points have already been or soon will be issued.

#### WORK OF THE YEAR.

During the fiscal year 1906 inspection was inaugurated at 23 establishments. One of these had previously had inspection, but had been destroyed by fire; the remaining 22, located in 13 different cities, were establishments that had not theretofore had inspection. Inspection was not conducted during the fiscal year for various causes at 11 establishments which had had inspection in the previous fiscal year. Of the 13 cities 6 were cities in which Federal inspection had not been

previously conducted. Below are shown the number of establishments and the number of cities where inspection has been conducted during each fiscal year since 1891:

*Number of establishments and cities where meat inspection has been conducted, 1891 to 1906.*

Fiscal year.	Number of establishments.	Number of cities.	Fiscal year.	Number of establishments.	Number of cities.
1891.....	9	6	1899.....	139	42
1892.....	23	12	1900.....	149	46
1893.....	37	16	1901.....	157	52
1894.....	46	17	1902.....	155	50
1895.....	55	19	1903.....	156	50
1896.....	102	26	1904.....	152	51
1897.....	128	33	1905.....	151	52
1898.....	135	35	1906.....	163	58

The following statement shows the number of ante-mortem inspections of animals intended for slaughter, an increase of 4.69 per cent over the figures reported for the previous fiscal year:

*Ante-mortem inspections for the fiscal year 1906.*

Kind of animals.	For official abattoirs in cities where inspections were made.	For other cities and miscellaneous buyers.	Total inspections.	Rejected (subject to result of post-mortem inspection).	
				At abattoirs.	In stock yards.
Cattle .....	7,045,353	6,462,494	13,507,847	1,875	47,307
Sheep .....	8,221,977	7,072,004	15,293,981	921	6,763
Calves .....	1,036,895	651,851	1,688,746	460	13,979
Hogs .....	26,026,484	12,333,513	38,419,997	5,861	83,474
Total .....	42,330,709	26,579,862	68,910,571	9,120	151,523

The following table shows the number of regular post-mortem inspections made, and indicates an increase of 6.66 per cent over the previous fiscal year. The condemnations show an increase of 33.82 per cent over the previous year, due largely to the closer lines of inspection for tuberculosis.

*Post-mortem inspections for the fiscal year 1906.*

Kind or animal.	Number of inspections.			Carcasses condemned.			
	For official abattoirs.	On animals rejected in stock yards.	Total inspections.	For official abattoirs.	Of animals rejected in stock yards.	Total.	Parts of carcasses condemned.
Cattle .....	6,887,001	38,525	6,925,526	16,659	3,780	20,439	4,016
Sheep .....	8,219,605	4,025	8,223,630	4,990	817	5,807	123
Calves .....	1,100,220	2,555	1,102,775	3,432	1,419	4,851	89
Hogs .....	26,580,964	68,389	26,649,353	121,243	6,613	127,856	121,931
Total .....	42,787,790	113,494	42,901,284	146,324	12,629	158,953	126,159

In addition to the carcasses condemned on regular and microscopic examination, others were tanked as follows:

*Carcasses of animals found dead or killed by local inspectors and tanked.*

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Total.
Died in yards.....	477	543	229	1,282	2,531
Killed in yards by local inspectors.....	417	164	6,694	10,537	17,812
Died at abattoirs.....	390	2,340	218	11,940	14,888
Total.....	1,284	3,047	7,141	23,759	35,231

The various diseases and conditions for which carcasses and parts were condemned and tanked during the year are shown in detail in the following table, which also includes animals found dead and those killed by local inspectors:

*Diseases and conditions for which condemnations were made, fiscal year 1906.*

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.	
	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.
Actinomycosis.....	797	1,985			2	1	13	5
Tuberculosis.....	13,548	1,114	4		25		95,396	113,491
Caseous lymphadenitis.....			680	3			1	
Hog cholera and swine plague.....							19,329	
Texas fever.....	328				280			
Echinococcus.....			6				1	15
Measles.....							13	
Scabies.....			2				26	
Eczema.....							3	
Erysipelas.....							22	
Cancer.....	22		4		1		11	
Tumors.....	9	3	7		1		624	275
Abscesses.....	94	242	108	22	24	2	1,256	419
Pneumonia.....	278		335		28		1,333	
Pleurisy.....	25		29	1	4		97	1
Carditis.....			4		1			
Enteritis.....	52		123		13		318	
Peritonitis.....	299		104		48		655	
Metritis.....	76		15		1		229	
Nephritis.....	2		11		9		37	
Uremia.....	8		26		3		49	
Mammitis.....			2				2	2
Septicemia.....	246		198		56		1,196	
Pyemia.....	456		201		51		3,033	
Gangrene.....	32		10		6	1	15	
Anemia, emaciation, marasmus.....	2,139		2,303		657		798	
Ascites.....			27		1		59	
Jaundice.....	9		488		18		920	
Asphyxia.....	19		46		2			
Arthritis.....			1		2			
Leukemia.....			2		2			
Pulmonary apoplexy.....			9					
Cysticercus tenuicollis.....			1					
Melanosis.....					2			
Extreme temperature, various causes.....			144		2		939	
Pregnancy.....	81		38				316	
Recent parturition.....	122		18				51	
Hernia.....	1		4				65	
Downers, bruise, injured, etc.....	1,786	672	833	97	391	85	1,019	7,723
Dead from various causes.....	867		2,873		444		13,222	
Too young.....			1		3,224			
Killed by local inspectors.....	417		164		6,694		10,537	
Total.....	21,723	4,016	8,821	123	11,992	89	151,615	121,931

The following table, showing the growth of the post-mortem inspection since it was first inaugurated, indicates that the number of

inspections made the past year was the largest in the history of the Bureau:

*Number of animals inspected at slaughter for abattoirs having inspection, 1891 to 1906.*

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889					83,889
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,079	92,947	870,512			4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146		12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539		18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191		23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771		26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199		31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936
1902	5,559,969	555,836	7,434,878	25,277,107	1,649	38,829,439
1903	6,134,410	668,855	8,585,960	21,793,738	344	37,183,307
1904	6,350,011	764,590	8,261,051	24,128,462		39,504,114
1905	6,096,597	845,862	7,872,671	25,323,984		40,139,114
1906	6,925,526	1,102,775	8,223,630	26,649,353		42,901,284

The meat-inspection brand or label was placed upon 24,163,869 quarters of beef, 8,154,490 carcasses of sheep, 1,094,946 carcasses of calves, and 939,656 carcasses of hogs. Sacks and barrels of meat were sealed as follows: Beef, 123,470; pork, 1,120,955.

White meat-inspection stamps, indicating the regular post-mortem inspection, were affixed to packages of meat and meat products as follows:

Beef	7,684,116
Mutton	32,701
Veal	2,437
Pork	15,940,227
Total	23,659,481

The number of cars sealed containing inspected meats and meat products was 76,956.

The movement of inspected meats between official establishments is shown in the following table. A large amount of work was involved in supervising the shipment of this meat and in identifying it on arrival.

*Movement of inspected meat between official establishments.*

Class.	Number of quarters and carcasses.	Smaller pieces (weight).
Beef	<i>Quarters.</i> 1,904,056	<i>Pounds.</i> 179,345,864
Mutton	<i>Carcasses.</i> 24,103	4,982,206
Veal	86,884	816,449
Pork	31,556	459,311,407

#### CERTIFICATES OF INSPECTION OF MEATS FOR EXPORT.

There were 42,784 certificates of ordinary inspection issued to cover meats and meat products for export as follows: 1,304,923 quarters, 9,597 pieces, 787 carcasses, and 1,598,229 packages of beef, weighing 390,291,533 pounds; 42 carcasses and 20,482 packages of mutton, weighing 609,373 pounds; 3,788 carcasses and 646,103 packages of



pork, weighing 201,453,171 pounds; a grand total of 592,354,077 pounds.

The following table shows, by years, beginning with 1898, the quantities of the different classes of meat for the exportation of which certificates of ordinary inspection were issued:

*Quantities of meat for export under certificates of ordinary inspection, 1898 to 1906.*

Fiscal year.	Beef.	Mutton.	Pork.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1898.....	339,650,091	324,996	244,956,482
1899.....	360,843,856	525,705	278,696,435
1900.....	438,138,233	680,897	272,050,663
1901.....	452,830,373	894,648	231,144,938
1902.....	416,990,762	1,145,248	188,360,011
1903.....	371,920,737	2,729,013	133,122,610
1904.....	419,058,781	712,089	154,442,440
1905.....	361,012,062	206,570	155,513,776
1906.....	390,291,533	609,373	201,453,171

The total cost of the work of ordinary meat inspection was \$789,263.76.

#### THE MICROSCOPIC INSPECTION OF PORK.

The number of hog carcasses examined for trichinæ was 536,997, classified as follows: Class A (free from all appearance of trichinæ), 523,945, being 97.57 per cent; class B (containing trichinalike bodies or disintegrating trichinæ), 6,220, being 1.16 per cent; class C (containing live trichinæ), 6,832, being 1.27 per cent.

The number of trichinous carcasses disposed of was 6,926, weighing 1,613,365 pounds, 47.24 per cent of which was tanked, the remainder being converted into cooked meat products.

The number of certificates issued for microscopically inspected pork was 3,104, covering 68,689 stamped packages containing 26,566,409 pounds of pork and pork products.

The following table shows, by years, the quantity of pork exported since 1892 to countries requiring microscopic inspection. The increase of 1906 over 1905 was 80.45 per cent.

*Quantities of pork exported to countries requiring microscopic inspection, 1892 to 1906.*

Fiscal year.	Pounds.	Fiscal year.	Pounds.	Fiscal year.	Pounds.	Fiscal year.	Pounds.
1892.....	22,025,698	1896.....	21,497,321	1900.....	55,809,626	1904.....	9,020,521
1893.....	8,059,758	1897.....	42,570,572	1901.....	35,942,404	1905.....	14,721,935
1894.....	18,845,119	1898.....	120,110,356	1902.....	33,681,229	1906.....	26,566,409
1895.....	39,355,230	1899.....	108,858,149	1903.....	19,108,341		

The cost of microscopic inspection was \$63,297.94, being an average of 11.79 cents for each carcass examined and 0.24 cent for each pound exported.

#### INSPECTION OF VESSELS AND EXPORT ANIMALS.

Seven hundred and forty-nine vessels carrying live stock were inspected before clearance. The number of certificates of inspection issued for American cattle exported to Europe was 1,312.

The following table shows the number of inspections of live animals for export and the number exported during the year:

*Number of inspections of American and Canadian animals for export, number rejected, and number exported, fiscal year 1906.*

Kind of animal.	American animals.			Canadian animals.		
	Number of inspections. <sup>a</sup>	Number rejected.	Number exported.	Number inspected.	Number rejected.	Number exported.
Cattle.....	805,045	1,516	<sup>b</sup> 416,372	46,874	11	46,863
Sheep.....	137,824	93	<sup>c</sup> 67,340	27,282	25	27,257
Horses.....	1,393	.....	1,252	6	.....	6

<sup>a</sup> The apparent discrepancy between the figures of this column and those of the two following columns is due to the fact that a large proportion of the animals were inspected more than once, thus making the number of inspections considerably larger than the actual number of animals, and that in a few cases part of the animals inspected and passed for export were diverted and slaughtered in this country by the owners.

<sup>b</sup> 34,181 via Canada.

<sup>c</sup> 4,314 via Canada.

All animals included in the foregoing statement as exported were shipped to Great Britain except 7,981 cattle and 77 horses to Belgium, 110 horses to Germany, and 150 horses to France.

Other animals were exported as follows: 2,597 cattle, 1,360 sheep, 21 horses, 144 mules, and 1,061 swine, of which 1,193 cattle and 1,153 sheep were destined to Bermuda, 130 cattle to Barbados, 1,345 cattle to Brazil; 30 cattle, 56 swine, and 11 horses to Argentina; 9 cattle to Mexico, 1 bull to British Guiana, 77 sheep to the West Indies, 1 horse to Jamaica, 100 mules to Cuba; 11 cattle, 1,005 swine, 44 mules, and 9 horses to Hawaii, and 8 cattle to Lower California.

The following table shows the number of animals inspected on landing at the three British ports where the Bureau maintains inspection and to which the greater part of the exports go, also the number and percentage lost in transit. It will be observed that under the Bureau's supervision of this traffic the percentage of loss is very low.

*Number of animals inspected at time of landing in London, Liverpool, and Glasgow, and the loss in transit, fiscal year 1906.*

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.	Per cent of loss.	Landed.	Lost.	Per cent of loss.	Landed.	Lost.	Per cent of loss.
United States...	380,980	535	0.140	65,650	220	0.334	902	9	0.998
Canada.....	38,750	130	.334	25,203	390	1.524	6	.....	.....
Total .....	419,730	665	.158	90,853	610	.666	908	9	.991

Special certificates of health were issued for the exportation of 2,830 cattle, 309 hogs, and 5 goats.

Tuberculin tests were made on 447 cattle in order to meet the requirements of the countries to which they were intended to be exported. Of these cattle 410 passed and 37 were rejected.

The total cost of the Bureau work in connection with the exportation of live animals was \$49,349.22.

## INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

In order to exclude from this country the contagion of the destructive animal diseases which exist in other parts of the world it is necessary to use the utmost vigilance with regard to imported animals. The perfection of the system of inspection and quarantine maintained on the Atlantic coast gives great protection to that section. Inspection is also maintained along the Canadian and Mexican borders, and arrangements are made for quarantine at certain points. As the Department refuses to permit the importation of animals from the Orient, owing to the great prevalence of dangerous animal diseases there, and as the importation of all kinds of animals from the Philippines is prohibited by Executive order for the same reason, no importations are permitted on the Pacific seaboard from across the seas. In spite of these precautions, however, there appears to be a possibility of contagion being brought in with forage or straw used as packing in China, or surreptitiously by pet animals. It is believed that the importation of forage from China and the use of hay or straw in packing goods for shipment from that country to the United States should be prohibited. There is especial danger that surra may be brought in by dogs from the Philippines, though the customs authorities have shown vigilance in preventing this.

All animals offered for importation are required to be inspected, and certain kinds, when coming from certain countries, are in addition required to be quarantined for a sufficient period to insure their freedom from contagion.

The following table shows the number of imported animals inspected and quarantined, and the number admitted on inspection without quarantine, during the fiscal year:

*Imported animals inspected, with or without quarantine, fiscal year ended June 30, 1906.*

## QUARANTINED.

Port of entry.	Cattle.	Sheep.	Swine.	Horses.	Mules and asses.	Goats.	Other animals.
New York .....	500	523	55			270	a 66
Boston .....	35	52					
Baltimore .....	72	15				1	
Canadian border ports:							
Beecher Falls, Vt. ....	70	14	1				
Buffalo, N. Y. ....	9	1	2				
Cape Vincent, N. Y. ....	2						
Charlotte, N. Y. ....	2						
Clayton, N. Y. ....	2						
Detroit, Mich. ....	3		1				
Eastport and Calais, Me. ....	4	41	2			2	
Fort Fairfield, Me. ....	39	51	2				
Hogansburg, N. Y. ....	2						
Island Pond, Vt. ....	17		3				
Massena, N. Y. ....	10	2					
Newport, Vt. ....	4	2					
Ogdensburg, N. Y. ....	9						
Sault Ste. Marie, Mich. ....	1						
Vanceboro, Me. ....	8	3					
Total quarantined .....	789	704	66			273	66

<sup>a</sup> Comprizes 4 antelopes, 1 anoa, 1 zebra, 1 stag, 1 waterbuck, 1 peccary, 2 wart-hogs, 2 zebras, 13 camels, 1 gnu, 1 aoudad, 3 gazels, 1 alpaca, 1 thamin (deer), 2 moufflons, 1 muntjac, 5 llamas, 19 deer, 1 markhor, 1 nilgau, 1 thar (goat), and 3 giraffes.

*Imported animals inspected, with or without quarantine, etc.—Continued.*

NOT QUARANTINED.

Port of entry.	Cattle.	Sheep.	Swine.	Horses.	Mules and asses.	Goats.	Other animals.
New York .....				2,650	33		<i>a</i> 2
Boston .....				92	3		
Baltimore .....				137	6		
Philadelphia .....				17			
San Francisco .....				2			
From Mexico:							
El Paso, Tex., <i>b</i> .....	18,258	15,795		104	153	2	
Eagle Pass, Tex. ....				7			<i>c</i> 13
Laredo, Tex. ....				106			<i>d</i> 12
Nogales, Ariz. ....	7,141	1	2	17	109	40	<i>e</i> 4
San Diego, Cal. ....	671	4,160	18	277	128		
Calixico, Cal., <i>f</i> .....	1,632			76	17		
Canadian border ports:							
Alburt, Vt. ....	1	24	1	15			
Beecher Falls, Vt. ....	13	7		35			
Bridgewater, Me. ....	1			2			
Buffalo, N. Y. ....	492	100,867	57	868		1	<i>g</i> 5
Calais, Me. ....				22	2		
Cape Vincent, N. Y. ....	145			31			
Chateaugay, N. Y. ....	110	10		38			
Clayton, N. Y. ....		5		1			
Derby Line, Vt. ....	4	29		68			
Detroit, Mich. ....	696	743	72	736	4		<i>h</i> 9
Eastport, Me. ....				23			
Fort Covington, N. Y. ....	27			24			
Fort Fairfield, Me. ....	22		1	129			
Hogansburg, N. Y. ....	1			17			
Houlton, Me. ....	2			5			
Island Pond, Vt. ....	10	144	2	60			
Lowelltown, Me. ....	38	1		13			<i>c</i> 2
Malone, N. Y. ....	155	18		45			
Massena, N. Y. ....	2	1		5		2	
Monticello, Me. ....				1			
Mooers, N. Y. ....	81			63			
Morristown, N. Y. ....	3	407		21			
Newport, Vt. ....	197	209	12	106		8	<i>i</i> 1
Niagara Falls, N. Y. ....	79	670	54	385			
North Troy, Vt. ....	73	13	2	16			
Ogdensburg, N. Y. ....	201	1	1	99			
Port Huron, Mich. ....	284	4,642	84	495	4		
Richford, Vt. ....	36	64	1	76			
Rochester, N. Y. ....				2			
Rouses Point, N. Y. ....	85	65		50		1	<i>e</i> 1
St. Albans Vt. ....	14	3		83			
Sault Ste Marie, Mich. ....	3			9			<i>j</i> 10
Swanton, Vt. ....	1	3	2	21			
Vanceboro, Me. ....	15	210		151			
Waddington, N. Y. ....	1			34			
Total not quarantined .....	30,494	128,092	309	7,234	460	54	59
Grand total .....	31,283	128,796	375	7,234	460	327	125

<sup>a</sup> Zebras.

<sup>b</sup> The figures for El Paso include 3,331 cattle, 92 horses, and 143 mules in transit to Mexico, and 772 cattle in transit to Canada.

<sup>c</sup> Deer.

<sup>d</sup> Four deer, 5 camels, 1 elk, and 2 llamas.

<sup>e</sup> Two deer and 2 tigers.

<sup>f</sup> The figures for Calixico include 2 cattle, 47 horses, and 8 mules, United States animals returned from Mexico.

<sup>g</sup> Three elephants and 2 camels.

<sup>h</sup> One deer, 1 elk, 2 llamas, and 5 camels.

<sup>i</sup> Freak bull.

<sup>j</sup> Four deer and 6 caribou.

In addition to its regular quarantine stations at Athenia, N. J., Littleton, Mass., and Halethorp, Md., for the ports of New York, Boston, and Baltimore, respectively, the Bureau in June, 1905, secured control of Simonson's Island, an isolated point located on the Fresh Kills, a tributary of Staten Island Sound, as a place of special quarantine in cases where more complete isolation of the animals was desirable. This arrangement was first made for the quarantine



of milch goats imported from Switzerland, under an agreement whereby the owner was to accept a per capita fee, to be paid by the importers, as a rental or compensation, the importer likewise paying for the necessary feed, bedding, and animal attendants, under the rule governing the quarantine of animals. A similar agreement has been made for another year. This island was used for the quarantine of 139 head of goats in October, 1905, 35 head of goats in May, 1906, and 51 head of cattle in June, 1906.

The quarantine stations on the Atlantic seaboard, with the exception of that at Halethorp (near Baltimore), are in a satisfactory condition. At the latter station most of the buildings are in a dilapidated condition, and for the purposes of the port of Baltimore the station is not suitably located. The ground immediately adjoining is being surveyed for a race course, and this will further render the station unsuitable for quarantine purposes, as it would be impossible to keep away from the quarantine grounds the people who would frequent the race track as employees and visitors. These circumstances will in all probability soon make it imperative to abandon the present station and find a new location. It is hoped that a location may be secured on the water front of the Patapsco River, which will permit the unloading of animals directly from steamers or barges to a wharf on the quarantine ground. Some investigations have been made of land so located, and it seems probable that satisfactory arrangements can be made for the use of such land. In order to equip the new station with buildings and inclosures, however, an appropriation will be absolutely necessary, and I recommend that Congress be asked to appropriate an amount sufficient for this purpose.

#### TUBERCULIN TEST IN GREAT BRITAIN.

For the convenience of importers of fine breeding cattle the Bureau has continued making tuberculin tests in England and Scotland of cattle intended for importation into the United States. The results of these tests during the fiscal year are shown in the following table:

*Results of tuberculin tests in England and Scotland of cattle for importation.*

Breed.	Passed.	Rejected.
Ayrshire .....	17	10
Guernsey (in England) .....	54	7
Dexter-Kerry .....	20	3
Shorthorn .....	10	2
Jersey .....	3	0
Aberdeen-Angus .....	31	2
Hereford .....	3	0
Dutch .....	30	9
Total .....	168	33

#### CONTROL OF CONTAGIOUS DISEASES.

The work of the Bureau for the control and eradication of contagious diseases has continued. This work during the past fiscal year, as heretofore, has consisted of the maintenance of a quarantine of the section infected with Texas or southern cattle fever and the

supervision of the movement of cattle from that section to points above the quarantine line; also the eradication of sheep scab, cattle mange, scabies in horses, and a venereal disease of horses known as *maladie du coït*.

#### TEXAS FEVER.

During the quarantine season of 1905 there were received at live-stock centers 47,496 carloads of cattle shipped for immediate slaughter from points below the quarantine line, the whole number of such cattle being 1,279,453. There were also inspected in the noninfected areas of Texas and Oklahoma 125,225 head of cattle which were permitted to be moved north for purposes other than immediate slaughter. Supervision was exercised over 100,916 dippings in crude petroleum, and over the cleaning and disinfection of 42,510 cars. The total cost of this work was \$45,984.81.

#### SHEEP SCAB.

In some States there has been a slight increase in sheep scab, but taken as a whole the condition is decidedly encouraging. The proportion of infected sheep during the past year was  $5\frac{1}{2}$  per cent of those inspected, while during the previous year it was  $7\frac{1}{2}$  per cent.

In Arizona the conditions are decidedly improved and the percentage of disease is less than in former years. Idaho, Utah, and Wyoming also show a decided improvement. During the fiscal year just closed the ratio of infected sheep in those States was 1 in 43, while for the previous year it was 1 in 14. It is expected that conditions in Utah and Wyoming will soon be such that the Department can remove the quarantine from those States. From a survey of the entire field there is cause for the belief that this disease is being gradually brought under control.

During the fiscal year the total number of inspections of sheep for scabies was 59,246,288, and the total number of dippings was 12,396,976, of which 1,661,020 were redippings.

The total cost of this work was \$181,414.39.

The following table shows the number of inspections and dippings of sheep for scabies, and cars cleaned and disinfected, 1900 to 1906:

	Fiscal year.						
	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Inspections.....	1, 801, 392	7, 912, 724	11, 186, 661	16, 444, 370	40, 967, 961	53, 680, 786	59, 246, 288
Dippings.....	626, 838	1, 034, 368	1, 017, 162	2, 167, 002	9, 578, 476	16, 873, 659	12, 396, 976
Cars cleaned and disinfected.....	.....	.....	791	752	2, 732	7, 965	8, 625

#### CATTLE MANGE.

During the fiscal year the Bureau, in cooperation with State and Territorial officials, has made rapid progress in the extermination of mange in cattle. The States of Washington and Oregon and large portions of the States of Kansas, Colorado, Wyoming, and Texas, and of the Territories of New Mexico and Oklahoma have been released from quarantine. The disease is being successfully controlled and eradicated in extensive areas in North Dakota, South Dakota,

Wyoming, and Texas, and the early release of these areas from quarantine may be expected.

The total number of inspections of cattle for scabies during the fiscal year was 14,983,260, and the total number of dippings was 243,826, of which 24,688 were redippings.

The total cost of this work was \$83,108.46.

The following table shows the number of inspections and dippings of cattle for scabies, and cars cleaned and disinfected, by fiscal years, from 1904 to 1906:

	Fiscal year.		
	1904.	1905.	1906.
Inspections.....	1, 124, 321	14, 085, 267	14, 983, 260
Dippings.....	162, 554	563, 394	243, 826
Cars cleaned and disinfected.....	532	29, 897	19, 992

#### SCABIES IN HORSES.

The total number of inspections of horses for scabies was 27,507, and the total number of dippings was 690.

#### VENEREAL DISEASE OF HORSES.

The insidious venereal disease of horses known as *maladie du coït*, or dourine, which has existed in portions of South Dakota, Nebraska, and Iowa, is believed to have been practically eradicated as a result of several years' vigilant work by the Bureau. During the past fiscal year 965 inspections were made, and only 3 cases were found that were considered sufficiently suspicious for condemnation—1 stallion and 2 mares. Neither of the latter showed lesions characteristic of the disease on post-mortem examination. The stallion was killed by the owner and had been buried several days before the inspector reached the place, when it was too late to make a conclusive post-mortem examination. Animals that may possibly have been exposed to the disease will be kept under close observation, and any reports of suspected cases will be promptly investigated until sufficient time has elapsed to warrant confidence that the eradication is complete.

#### TEXAS FEVER INVESTIGATIONS AND TICK ERADICATION.

Special attention has been given during the year to the study of the disease commonly known as Texas fever, of the life history of the tick which transmits this fever, and of the methods for eradicating these fever ticks, in view of the proposed campaign for the eradication of the ticks from the infected section. For the purpose of giving information to the public on this subject two bulletins (Bureau Bulletin No. 78 and Farmers' Bulletin No. 258) have been prepared by Dr. John R. Mohler, chief of the Pathological Division, and issued during the year.

The Bureau has taken up with the various State and Territorial authorities the subject of eradicating the ticks, with a view to ascertaining whether or not the laws and regulations of the various States



and Territories would permit of conducting a vigorous campaign against the fever tick. The State and Territorial laws should give to local officers authority to enter premises, to inspect live stock, and to enforce the necessary quarantine and disinfection. The laws should also give authority to the proper State officials to issue rules and regulations and to confer authority upon Federal representatives to act as officials of the State in such matters. Funds should also be provided for the employment of local inspectors. In a number of the States the laws respecting this subject are defective, and it is urged that such laws be enacted by the different States in the infected area as will enable close cooperation between this Bureau and the State in the work of eradicating cattle ticks.

Anticipating legislation by Congress making provision for cooperative work with State authorities for the eradication of the ticks, the Bureau made plans to place additional inspectors in the field and to cooperate with the local officials in the different infected localities in an endeavor to exterminate cattle ticks by the various methods. The act of Congress approved June 30, 1906, made an appropriation for this work, and it will be taken up actively at once under the supervision of Dr. R. P. Steddom, chief of the Inspection Division. It is expected that as a result of these efforts a number of counties and parts of counties in the vicinity of the present quarantine line will be freed from the ticks during the ensuing year so that the cattle can be released from restrictions. By directing the principal efforts from the quarantine line southward it is believed that the infested territory can be gradually reduced and the line pushed farther south from year to year. It should be understood, however, that the complete eradication of the ticks from the entire section is an undertaking of great magnitude and difficulty and one that will require several years for its accomplishment.

Experiments have been conducted at the Bureau Experiment Station near Washington, D. C., also in Virginia, and, with the cooperation of the South Carolina Experiment Station, at Clemson, S. C., regarding the life history of the Texas fever tick and the exact time required for the tick to live parasitically on the cattle as well as the length of time it can exist without a host. As a result of these investigations several methods for the eradication of ticks, which have been found to be satisfactory for the States in which they were tried and under the climatic conditions met during the experiments, have been recommended in the bulletins mentioned.

Besides the six methods already published there have been several combinations of these methods tried on certain farms with entirely satisfactory results. Thus, on one Virginia farm where the conditions were not such as to warrant the use of any one of the outlined plans in its entirety, a combination was suggested which has succeeded in completely ridding the cattle and premises of ticks. The 16 dairy cattle were removed from the infected pasture on September 10 and then placed on a cultivated field where they were soiled. All ticks were carefully removed by hand three times weekly and burned. In this manner no tick was permitted to mature or to drop off during the egg-producing age. The cattle, which soon became tick free, were not placed on the original pasture until May 1, by which time it had also become free of ticks, and it has remained so.



A somewhat similar combination proved successful on another dairy farm in Virginia. The infected cattle were taken from one pasture early in June, 1905, and placed on a second pasture, from which they were moved September 11 to a cultivated field, where they were hand picked three times weekly. As no noninfected pasture was available and it was not desirable to go to the expense of fencing the field, these cattle were kept free of ticks by hand picking and by mopping with crude petroleum that portion of the skin usually infested with ticks, and were continued on this cultivated land until fall, when they were placed in a barn which had been previously well disinfected with a chloride of lime solution and the barnyard cleaned of all manure, litter, and other harborers of ticks and eggs. The following spring the two pastures, which in all probability were by that time free of ticks, were nevertheless burned off for the sake of safety, and the cattle were placed thereon in April and have since given no indication of becoming tick infested.

Experiments relative to the dropping off of ticks from cattle in feed lots were tried at the Bureau Experiment Station, also in Virginia and South Carolina, and the results were published in Bulletin No. 78.

The cooperative work being done in South Carolina consists of two demonstrations which have for their object the eradication of the Texas fever ticks from Oconee and Pickens counties. One demonstration has for its basis the known fact that the adult tick drops off the cattle to lay its eggs, after which it dies, and the young ticks can never reach maturity unless they gain access to the body of a host animal, in the absence of which animal they perish after varying lengths of time. The method being followed on one large farm heavily infested with ticks consists in pasture rotation, in the operation of which the original pasture is divided into two by a double line of fence about June 1, and the cattle are moved into one half, where they remain until September 10, after which they are moved three times at intervals of twenty days to fresh tick-free land from which the crops have been gathered. The cattle are then free from ticks, and on November 10 they are moved to the half of the original pasture, which had been kept free of animals since June 1, by which time all the ticks it contained will have perished. By the following May all ticks on the other half will also have disappeared, both farm and cattle will be free of ticks, and the double line of fence can be removed. The second demonstration consists in the location of all the infected farms in the above-mentioned counties, and in hand mopping all the cattle on these infected farms in the fall with Beaumont crude petroleum to catch the last crop of ticks, and a similar treatment at the beginning of spring to kill all of those ticks which have survived the winter. This method has been followed with very satisfactory results, and the possibility of applying the same mode of treatment to cattle on large ranches by dipping with the view of destroying the last crop of ticks in the fall and the first crop in the spring is now receiving consideration.

In the practical operation of any method already outlined, or a combination of two or more of these methods, it is to be hoped that the Bureau will receive the cooperation as well as the support of all southern agriculturists, which is so essential if the ultimate object

of tick eradication is to be obtained. And there is small use of one farmer or set of farmers freeing their lands and cattle of the parasites if their lands and cattle are to be constantly exposed to the danger of reinfestation from the ticks of their immediate nonprogressive neighbors.

A simultaneous experiment with the same generation of ticks has been inaugurated at the Bureau Experiment Station and at the South Carolina Experiment Station in order to determine if the first crop of ticks is less virulent than later crops or if the cattle in the cooler spring months are not so susceptible as in the hot summer months, but this experiment has not been concluded.

A considerable amount of work was done by the Bureau station in an attempt to discover a more satisfactory method than that in common use for the production of immunity in cattle against Texas fever. The method now in use is unfortunate in that it frequently causes quite severe disease and occasionally the death of the treated animals. The experiments have not progressed sufficiently to merit more than a simple reference to them.

Further investigations have been made relative to the persistence of the parasite of Texas fever in the blood of southern cattle after their removal from all sources of fresh infection or reinfection and the significance of this persistence. A report on these investigations, also a general article on the southern cattle tick, have been prepared for publication in the Twenty-second Annual Report of the Bureau.

## **TUBERCULOSIS.**

### **EXPERIMENTS IN IMMUNIZING CATTLE.**

A number of prominent investigators, both in this country and in Europe, have recently been testing and recommending various methods for the protective inoculation of cattle against tuberculosis. Their systems of operation are mainly based upon similar processes; that is, they all inject the cattle with tubercle bacilli of either human or bovine origin. There is, however, considerable variation in the manner of administering the injections and also in the number of applications considered necessary to produce adequate protection for the animal, and there is also a difference in the preferred age at which the cattle are to be treated. In order that the most promising of these methods for immunizing cattle against tuberculosis might be tested and that new features which are greatly to be desired and which are lacking in present methods might be perfected and proved, some comparative experiments have been conducted by the Pathological Division with the cooperation of the Experiment Station. A number of calves have been inoculated in a variety of ways and with differing amounts of living tubercle organisms from varied sources. Numerous check animals are also being used, and these, with the several lots of test cattle, will later be subjected to exposure to virulent tubercle bacilli. The lot of cattle showing the greatest proportion of resistant animals at the completion of this experiment will be selected as representing the most feasible and effective method of immunizing cattle against tuberculosis. It is very desirable that perfect protection be afforded the cattle, if possible, by a single in-

oculation of the protective virus. It is therefore one of the aims of the present work to select cultures possessing the greatest degree of virulence compatible with safety to the animals treated and at the same time to select some part of the animal's body as the seat of the injection that is but little liable to convey the micro-organisms to the glandular system, where they might readily cause the establishment of a generalized case of the very disease which it is so desirable to guard against. Owing to the slow development of tuberculosis naturally, no absolute selection of the best from among these various methods of protection can be made until the animals have proved by long exposure their ability to withstand the attacks of the tubercle bacilli.

#### TUBERCULOSIS IN HOGS.

Another phase of the subject of tuberculosis which has received a great deal of study by the Pathological Division is the increase in the number of tuberculous hogs received at abattoirs where Federal inspection is maintained. The records of the post-mortem inspectors at the various packing houses have been examined with a view to ascertaining the geographical location of the most serious centers of the disease, and at the same time tabulated forms have been prepared which show at a glance the proportion of cases in which the disease is limited to the throat of the hog, those where the lesions are localized but are established elsewhere than in the throat, and finally the proportion of serious generalized cases. It has been found that approximately 92 per cent of the 96,000 hogs thus reported tuberculous were affected in the cervical glands, and that some 30 per cent of these had no other lesion. The necessity of careful inspection of each head at the time of slaughter needs no further demonstration.

An effort has been made by the Pathological Division in conjunction with the Experiment Station to discover the most probable source of infection of these animals. It has been found that wherever tuberculous hogs are marketed from a farm the cows of that farm are tuberculous, or else the hogs have been fed upon skim milk or separator refuse from some public creamery, to which the milk of tuberculous cows, or perhaps of but a single tuberculous cow, is delivered. Separator sediment has been obtained from several suspected creameries, and animal inoculations and microscopic examinations have demonstrated the presence of tubercle bacilli in 25 per cent of the samples of such refuse, thus proving the necessity of guarding calves and pigs from this source of infection. Such milk may be sterilized by warming to 176° F. (or 80° C.). One instance of serious infection was discovered, where the tuberculous cattle which originally brought the disease to the ranch had been destroyed. Still the disease persisted in attacking on an average some 24 per cent of the hogs marketed from the place during the following three years. Investigation then showed that the brood sows, which had been retained for some time, were badly infected and that they served as sources of tubercular contamination to each succeeding generation of pigs.

The investigations during the past year have therefore included the infection of sucking pigs through the tuberculous mammae of their mothers. Other hogs have been exposed to infection by following



tuberculous cattle, where they had full access to all excretions from them, others have been fed with tuberculous milk, and still others have been penned with cattle that were being fed upon tubercle bacilli of artificial cultivation in order that the infectiveness of the bacilli after passage through the alimentary tracts of the cattle might be observed. It was shown that hogs readily contract tuberculosis from eating the feces of tuberculous cattle and that this is probably one of the commonest causes of tuberculosis among hogs. Hogs were found invariably to show tuberculous disease of the lymph glands located at the angles of the jaws when infection reached their bodies through ingestion. Tubercle bacilli given cattle in their drinking water were found to pass through the entire length of their digestive apparatus and to appear in their feces without having lost the power to produce tuberculous disease. This last fact indicates that animals with tuberculous lungs, while they do not expectorate after coughing up tuberculous material, nevertheless scatter bacilli freely, by swallowing them, having them pass through their intestines, and discharging them with their feces.

Experiments in the application of the tuberculin test to hogs were also made in connection with the above studies, and it was shown that, if the proper precautions are taken, the diagnostic value of tuberculin with hogs is as great as with cattle. A method of procedure which was reliable in 97 per cent of the animals tested has been found. Bulletin No. 88, which contains full information upon these subjects, has just been issued.

#### OTHER EXPERIMENTS WITH TUBERCULOSIS.

It was shown by the investigations of the Experiment Station that the locations of lesions in the bodies of animals affected with tuberculosis is no guide as to the mode of infection, and that pulmonary disease is the most frequent form in which tuberculosis occurs is not necessarily because the commonest mode of infection is through the respiration, but more probably because of the relation of the lymphatic stream to the venous circulation and the filtration by the lung of the venous blood after the lymph has been poured into it and before it reaches any other organ.

Guinea pigs, which are generally regarded as extremely susceptible to tuberculosis, irrespective of the manner in which they are brought in contact with the infection, were found to possess a high degree of immunity when the infectious material entered their bodies through ingestion in the form of artificially infected milk. The contrary was shown to be true of hogs, which were found to be very susceptible to ingested infection of the kind that failed to injure the guinea pigs. It should be added that the immunity of guinea pigs to ingested tuberculous infection has a parallel in a similar immunity possessed by them to respired infection. Among many hundreds confined for varying periods of time during the last ten years in a small one-room animal hospital, which contained tuberculous guinea pigs at all times and for long periods of time, also tuberculous monkeys and rabbits, only one guinea pig is known to have contracted tuberculosis. This one animal became affected with what may be called, to distinguish



it from artificially induced disease, naturally acquired tuberculosis through the intensest kind of exposure. It was one of three young produced in a small cage containing six adult females affected with generalized tuberculosis. The tuberculous mother nursed this and the other two young, which remained healthy.

To injected tuberculous infection, quite independent of the character of the injection, guinea pigs have always been found to possess the high susceptibility with which they are commonly credited. This subject has been gone into at some length because it is of considerable importance in view of the extent to which guinea pigs are used by investigators in their studies of tuberculosis.

The examination of the feces of a number of tuberculous cattle showed that they are frequently very rich in acid-fast bacteria; that is, bacteria which have the microscopic appearance of and conduct themselves precisely like tubercle bacilli in the presence of various reagents. Such acid-fast bacteria could not be detected in the feces of the station cattle that are free from tuberculosis. In two cases, with the feces of two tuberculous cows, the acid-fast bacteria were definitely proved by inoculation tests to be tubercle bacilli. That the feces of tuberculous cattle may contain innumerable virulent tubercle bacilli must be regarded as a seriously important fact.

Cultures of tubercle bacilli which have been used since 1902 for the study of the transformation of characteristics of tubercle bacilli following their long-continued cultivation under artificial conditions have been kept under observation in the Pathological Division during the year, and the changes which have occurred in them have been noted.

Tubercle bacilli have been recovered from several rare animals at the National Zoological Park, such as the rattlesnake, the camel, the beaver, kangaroo rats, and the roughed or crab-eating fox, and it is of interest to note that these animals suffer from natural infections with tuberculosis, and that in most instances the micro-organisms present conform to the human type of tubercle bacilli.

#### DISTRIBUTION OF TUBERCULIN.

The demand for tuberculin, which is prepared in the Biochemic Division and furnished free of charge by the Bureau to authorized health officers in the various States and cities, greatly increased during the past year. The total amount of tuberculin prepared and shipped during the year was 103,510 doses, an increase of approximately 40 per cent over the amount sent out during the previous fiscal year.

#### HOG CHOLERA INVESTIGATIONS.

In the previous annual report the results of the experiments concerning the etiology of hog cholera were briefly described. The Biochemic Division, in pursuing this work further during the past fiscal year, has demonstrated that the filterable virus which has already been shown to be the primary cause of hog cholera in southwestern Iowa is also present in outbreaks of that disease occurring in eastern Nebraska, in central Iowa, and in Virginia. The outbreaks which

have been studied in these localities possessed all of the well-known characteristics of hog cholera. These experiments demonstrated that the filterable virus is not peculiar to hog cholera as it is found in southwestern Iowa, and they also indicated that this virus was widely distributed and probably the active causative agent of all outbreaks of that disease. A number of experiments having for their object the determination of the mode of transmission of the disease, the portal of entry of the virus into the hog's body, the length of life of the virus outside of the hog's body, and the nature of the virus itself, have been carried out, and the results will all be published later in bulletin form.

In connection with the other experiments the bactericidal action of hog's blood has been investigated and the results are now ready for publication. It is very gratifying to note that these recent experiments have substantiated in every way the results published in Bulletin No. 72.

In addition to the work just described, a certain number of experiments concerning the production of immunity from hog cholera have been arrived at, these immunity experiments being based upon the recently demonstrated fact (see Bulletin No. 72, Bureau of Animal Industry) that the primary cause of hog cholera exists in the blood of hogs sick of that disease, but not in pure cultures of *Bacillus cholerae suis*, which had previously been regarded as the cause of hog cholera. In a general way, the methods employed may be said to embrace the following general principles:

- (1) The injection of hogs immune from hog cholera with blood from hogs sick of that disease.

- (2) The drawing of blood from the immune hog hyperimmunized by injections of diseased blood, and the use of this immune blood, either alone or in conjunction with diseased blood, for immunizing healthy hogs or treating those sick of hog cholera.

By methods based on these principles we have secured from each of three different immunes, treated with different strains of diseased blood, sera which in doses of 10 c. c. to 20 c. c. afforded complete protection to nonimmune hogs against an infection which was fatal to from 70 to 100 per cent of untreated animals.

In view of these favorable results the process was patented in such a manner as to insure to all the people in the United States the right to its use free of any royalty, the patent being taken out in this way by Dr. M. Dorset, chief of the Biochemic Division, who planned and directed the investigations. The number of experiments thus far carried out is not considered sufficient to warrant the present recommendation of this process for general use, but further experiments are being pushed as rapidly as is consistent with thoroughness, and it is hoped that a detailed statement of the results obtained may be made during the present year.

Experiments in the prevention of hog cholera by selective breeding are being continued with the object of developing by artificial selection a race of hogs which will possess partial or complete immunity from hog cholera. This work, which is carried on by the Biochemic Division in cooperation with the Experiment Station, was begun several years ago, naturally immune hogs being used as a basis and each litter exposed to infection. Thus there were retained

out of each litter only those animals which showed the greatest powers of resistance. Several generations of animals have been exposed to disease during the last two or three years and the work is still being carried on, but sufficient results have not been obtained to warrant an expression of opinion as to the final outcome.

### GLANDERS.

During the year isolated outbreaks of glanders have been reported from various quarters, and material from suspected cases has been forwarded to the pathological laboratory for examination and diagnosis. Nasal secretions and tissues from horses were received from North Dakota, Connecticut, Maryland, Virginia, and the District of Columbia. The samples from Connecticut proved negative for glanders, but positive results were obtained from all other sources. Cases occurring in the District of Columbia come directly under the supervision of the Chief of the Bureau of Animal Industry, who directs the disposition of the animals, the isolation and testing of exposed animals, and the disinfection of the premises.

Of very great importance for the diagnosis of glanders is the Gruber-Widal reaction, first recommended by MacFadyean in 1896, which has been made use of during the past few years. It has been employed in a number of cases quite successfully, but up to the present time has not been used as a routine measure, as the character of most of the specimens received make it necessary to rely for diagnosis either upon the Strauss inoculation method or the isolation of the specific bacillus itself. The Strauss method, in our hands, has also given excellent results, and but for the time required would be an ideal means of diagnosis.

The serum diagnosis (or the Gruber-Widal test) of glanders consists in the addition of fixed, definite quantities of blood serum from the suspected animals to young cultures of the *Bacillus mallei*, and, if the case be positive, results in an agglutination or aggregation of the isolated bacilli into small clumps, which eventually cling to the side or drop to the bottom of the tube of culture medium in which they have previously been held in suspension.

### DISTRIBUTION OF MALLEIN.

The Bureau has continued to furnish mallein free of charge to authorized health officers and to the War Department, and during the fiscal year 10,105 doses, prepared by the Biochemic Division, were so distributed. This represents an increase of about 40 per cent over the distribution of the preceding fiscal year.

### BLACKLEG.

The great demand for blackleg vaccine still continues, thus showing the confidence of the stock raiser in the efficacy of vaccinating his young cattle for the prevention of spontaneous outbreaks of this virulent disease. During the year there have been prepared in the Pathological Division and distributed among stock owners 1,350,915 doses of vaccine.

The results of inoculations for the year ending June 30, 1905, as



reported to the Bureau by the stock raisers who have used the vaccine, are as follows:

*Results obtained from vaccine distributed during the fiscal year ended June 30, 1905.*

State or Territory.	Number of reports.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					
			Number.	Per cent.	Within 48 hours.	From 2 to 7 days after.	Within 1 year.	Number of cases due to mistakes.	Total number.	Percentage of deaths.
Arizona.....	50	5,320	318	5.97	5	4	18	.....	27	0.57
Arkansas.....	20	826	67	8.11	.....	5	1	.....	6	.72
California.....	403	47,064	819	1.74	15	30	144	4	193	.41
Colorado.....	609	65,663	896	1.36	17	58	219	5	299	.45
Idaho.....	38	2,788	114	4.09	1	1	.....	.....	2	.07
Illinois.....	72	3,076	129	4.18	.....	4	21	.....	25	.81
Indiana.....	11	501	14	2.79	.....	.....	.....	.....	.....	.....
Indian Territory...	36	3,686	173	4.69	.....	2	47	.....	49	.10
Iowa.....	111	7,402	144	1.94	5	6	100	3	114	.15
Kansas.....	522	68,749	878	1.27	20	60	174	2	256	.037
Kentucky.....	16	634	27	4.25	1	2	2	.....	5	.078
Michigan.....	3	52	.....	.....	.....	.....	.....	.....	.....	.....
Minnesota.....	15	640	24	3.75	2	2	1	.....	5	.078
Mississippi.....	5	263	5	1.9	.....	.....	4	.....	4	1.5
Missouri.....	658	26,554	453	1.7	15	20	81	8	124	.46
Montana.....	274	32,313	455	1.4	6	22	94	6	128	.39
Nebraska.....	1,534	132,150	1,858	1.4	60	107	458	21	626	.47
Nevada.....	5	604	8	1.32	.....	.....	3	.....	3	.49
New Hampshire.....	2	43	.....	.....	.....	.....	.....	.....	.....	.....
New Mexico.....	30	8,758	181	2.06	.....	.....	97	.....	97	.11
New York.....	13	252	16	6.34	.....	.....	5	.....	5	.19
North Carolina.....	37	1,482	50	3.37	.....	1	3	.....	4	.27
North Dakota.....	345	29,444	515	1.74	30	10	104	11	155	.52
Ohio.....	51	18	6	3.33	.....	.....	.....	.....	.....	.....
Oklahoma.....	56	8,267	112	1.35	5	30	10	1	46	.55
Oregon.....	71	9,513	121	1.26	1	4	21	.....	26	.27
Pennsylvania.....	1	600	.....	.....	.....	.....	.....	.....	.....	.....
Porto Rico.....	3	600	10	1.66	.....	.....	6	.....	6	1.00
South Dakota.....	433	48,226	703	1.45	10	80	134	16	240	.49
Tennessee.....	43	1,705	66	3.87	1	3	16	.....	20	1.11
Texas.....	959	149,248	2,278	1.52	57	210	886	14	1,167	.77
Utah.....	24	3,162	29	.91	1	3	.....	.....	4	.012
Vermont.....	2	19	.....	.....	.....	.....	.....	.....	.....	.....
Virginia.....	359	8,497	272	3.21	.....	9	27	4	40	.47
Washington.....	44	2,360	68	2.88	.....	5	7	.....	12	.51
West Virginia.....	115	3,622	83	2.2	3	1	25	.....	29	.8
Wisconsin.....	9	538	18	3.7	.....	.....	8	.....	8	1.4
Wyoming.....	306	58,782	471	1.8	14	30	170	24	238	.4
Total.....	7,235	733,421	11,381	1.55	269	709	2,866	119	3,963	.54

After eliminating the number of cattle which die within forty-eight hours after vaccination as a result of being already infected with blackleg at the time of injection, and those whose death has been due to mistakes in performing the operation, the number of cases that died after vaccination is reduced to 3,575, or 0.48 per cent, whereas the losses without the use of vaccine were formerly as high as 10 or 12 per cent of the calves produced annually in the infected districts.

#### RABIES.

Within the District of Columbia there has been a considerable reduction in the frequency of cases of rabies during the past year. Of the 30 suspected cases examined in the laboratory of the Pathological Division from all sources, 16 proved positive, of which number only 8 came from within the District, as compared with 13

for a similar period of time last year, or a reduction of 38 per cent. In the following table the source and species of the animals affected and the result of the experimental animal inoculations and microscopic examination of the plexiform ganglia, together with the number of persons or animals bitten, are given:

*Results of inoculation tests and microscopic examination for rabies.*

Date.	Record No.	Kind of animal.	Received from—	Result of inoculation.	Diagnosis by histological examination.	Persons or animals bitten.
1905.						
July 3	388	Steer .....	District of Columbia	Positive	None made	
Sept. 5	394	Dog .....	Flat Rock, N. C.	do	do	1 woman, 2 dogs.
Sept. 29	395	do	District of Columbia	do	do	
Oct. 4	396	do	Drivers, Va.	do	Positive	1 child.
Oct. 23	397	do	District of Columbia	do	do	1 man.
Nov. 9	398	do	Fairlands, Md.	do	do	1 man; scratch.
Nov. 11	399	do	District of Columbia	do	do	1 child.
Nov. 13	400	do	do	do	do	1 girl.
1906.						
Jan. 12	414	do	Landover, Md.	do	do	2 men.
Jan. 13	417	do	Rockville, Md.	do	do	
Jan. 16	422	do	Arlington, N. J.	do	do	Several men and dogs.
Mar. 8	504	do	Norfolk, Va.	do	Not characteristic.	1 girl.
Apr. 21	558	do	District of Columbia	do	None made	
May 28	596	do	do	do	Positive	4 persons.
May 29	598	do	do	do	None made	
June 16	614	do	Blacksburg, Va.	do	do	Several dogs.

In the 10 positive cases in which the plexiform ganglia were sectioned there was only one case (No. 504) in which the lesions were not sufficiently marked to base a positive diagnosis without waiting two weeks for the rabbits to develop the symptoms, and in this case the dog was killed during the course of the disease. This demonstrates the necessity of allowing the animal to die naturally from the effects of rabies if an early diagnosis by means of a ganglia examination is to be assured.

Rabies has been quite prevalent, however, in the portion of Maryland adjacent to the Bureau Experiment Station, and several dogs have been tested at the station. It is believed that this locality is not more especially infected than many other places, but that the frequency with which rabies is found there within a small circumscribed area is probably due more to the careful attention given to the subject than to the more common occurrence of the affection.

The great variations in the histories, symptoms, and autopsy lesions of rabid dogs makes a diagnosis practically impossible without inoculation or microscopic tests. Our experience is such that we regard it as real wisdom to place under proper restraint at once every dog that shows abnormal symptoms of any kind. The restraint need not and should under no circumstances be of a cruel kind. It is much easier to terminate a temporary restraint after the dog has recovered than to correct the damage he could do if his affection proved to be rabies.

During the year three experiments were made by the Pathological Division in order to test the effect of filtration on the virus of rabies. The material used was taken from rabbits dead as a result of inoculation with street virus. The brain was removed, macerated in a mortar, and made into an emulsion with physiological salt

solution. This emulsion was then mixed with a bouillon culture of *Bacillus proteus vulgaris* of Häuser and filtered through a Pasteur-Chamberland B filter, the filtration being hastened by a vacuum of 25 inches. Cultures made from the filtrate remained sterile, and rabbits inoculated intracerebrally with the material remained healthy, while the check animals inoculated in a similar manner with the nonfiltered emulsion died in every case with typical symptoms of rabies. We therefore conclude that the virus is nonfilterable.

Having established this fact, it was then decided to make routine examinations for the presence in the Purkinje cells of the cerebellum and in the cells of the hippocampus major of the so-called Negri bodies which have recently been considered as the etiological agents of the disease. These bodies are cell inclusions found by Negri in 1903, and claimed by him to be protozoa and the specific cause of rabies. They vary in size from 0.5 to 25 microns in diameter, and while the filterability of these bodies may not be impossible, nevertheless the failure of the virus of rabies to pass through the fine meshes of a Chamberland B filter in the above-mentioned experiments seems to be additional proof of the etiological significance of these cell inclusions. They have been found varying in size, shape, and number in all the positive cases for which they were examined, but in none of those cases which were proved negative by other tests. As these examinations did not include all the cases that were received during the fiscal year the results have not been included in the above table; but it is apparent that the finding of Negri bodies in the brains of animals suspected of rabies is the most satisfactory and most rapid means available for the diagnosis of this disease.

### MISCELLANEOUS INVESTIGATIONS OF DISEASES.

#### SO-CALLED BOTTOM DISEASE OF HORSES.

"Bottom disease," an affection of horses pasturing in the bottom lands along the Missouri River in Iowa and Nebraska, is under investigation by the Pathological Division. At the present stage of the work there appears reason for associating this malady with an affection of cattle known in Nova Scotia as Pictou disease, with Winton disease of horses of New Zealand, and with Molteno cattle disease of South Africa. The tissues examined present practically the same lesions as those described for the above-mentioned affections, namely, interlobular connective tissue hyperplasia, fatty infiltration of the liver cells, and hemorrhages into the spleen.

Pictou disease, Winton disease, and Molteno cattle disease have been investigated time and again in an endeavor to find a causative agent. All inoculation experiments have failed, and it has only been found of late that feeding experiments with certain weeds have given seemingly reliable results.

Pictou disease, occurring in Pictou and Antigonish counties, Nova Scotia, is now ascribed to the ingestion of a weed called ragwort. Winton disease is thought to be caused by a member of the ragwort family, *Senecio jacobæa*. The Molteno disease of South Africa is probably induced, according to recent investigations, by still another



ragwort, *Senecio burchelli*. At least these weeds when fed to the animals in their respective localities have produced diseases followed by a train of symptoms corresponding to those seen in the naturally induced disease. The post-mortem findings were also quite similar. It was also proved that these plants were most dangerous in the young state. Yet another variety known as *Senecio latifolius* was found to be deadly to stock.

Feeding experiments have been planned by the Bureau, and a study of the varieties of weeds found in the infected area of Nebraska and Iowa is now in progress.

#### A MOUTH DISEASE OF GOATS.

Within a week after the importation of 34 Saanen and Toggenburg goats from Switzerland and while they were still held in quarantine at Simonsons Island, New York, a peculiar mouth disease simulating the virulent foot-and-mouth disease of Europe was observed by the superintendent of the quarantine station, who immediately telegraphed for the pathologist of the Bureau to make an investigation. On arrival it was found that at least 32 per cent of the flock was showing more or less advanced symptoms of the disease. After a careful clinical examination of all the affected animals, which included the taking of temperatures and the examination of the mucous membranes of the mouth, eyes, and nostrils, a diagnosis of impetigo labialis was made. This disease is also known as facial dermatitis, orf, and cursta labialis in England and Scotland, and teigmaul and maulgrind in Germany. Reports have been received of its prevalence in Canada, West Indies, and several sections of the United States.

The lesions in the early stages usually appear as an acute localized inflammation of the skin on the outside of the lips. This pimple-like formation is attended with much inflammatory swelling with a decided tendency to the formation of pustules. They dry and form crusts of a dark grayish color and of a fungoid appearance. The growths extend rapidly and become confluent in the course of a few days, forming a large diffuse scab, which is found when removed to cover a suppurative surface. Simultaneously with this the lips become tumefied, swelling to three or four times their normal thickness. The appetite usually remains good, but the animals feed with great difficulty owing to the sensitiveness of the affected parts. In the most advanced cases the scab extends from the lips up over the cheeks and eyes, and in some instances a muco-purulent nasal discharge appears, which adheres to the nostrils and, together with the swollen condition of the surrounding tissues, causes a more or less complete occlusion of the air passages, resulting in labored breathing upon exercise. In some cases the lesions extend into the mouth, producing erosions on the inside of the lips, on the gums, and on the maxillary pad of the hard palate. These lesions, which are of a spongy consistency and present a papillomatous appearance, were especially noted on the smaller goats. Similar wartlike growths have been noticed on the teats and udders and on the legs, especially about the coronet and in the fold of the fetlock. The disease has been transferred to sheep and goats, but cattle appear to be insus-

ceptible. Work is at present being performed with the view of determining the nature of the causative agent of the affection.

The lesions readily yield to a treatment of boracic acid, sulphur, and petrolatum, and one or two applications are usually sufficient to cure every case without complications. In fact, the disease appears to respond quickly to any of the common antiseptic solutions.

#### ROUNDWORMS IN SHEEP.

Throughout the more thickly settled regions of the United States one of the most important factors, if not the most important one, in the lack of success commonly experienced in sheep raising is the damage caused by internal parasites, and thousands of farmers in the eastern half of the United States have been driven to abandon the sheep industry because of losses among their flocks due to parasitic infection. The roundworms occurring in the alimentary canal are as a group probably the most important of the parasites of sheep, comprising no less than fifteen to twenty distinct species, some of which are both very common and decidedly injurious.

Because of their importance an investigation of these parasites has been undertaken by the Zoological Division with the intention of describing the various roundworms parasitic in the alimentary canal of ruminants in order that they may be distinguished from one another and determining as far as possible their life histories, from a knowledge of which practicable methods of preventing infection may be devised. Considerable progress has been made in this investigation, inasmuch as the principal facts in the life history of *Hæmonchus contortus*, commonly known as the stomach worm or twisted wireworm of sheep, have been established. This species, whose life history was heretofore unknown, is probably the most important of all the roundworms occurring in sheep. The eggs of the parasite are scattered over the pastures in the droppings of infested sheep or cattle. Under suitable conditions of heat and moisture they hatch in a few days, and within about two weeks the embryos develop to a stage in which they are enveloped in a cuticular sheath without openings. Prior to this stage the embryos are easily killed by freezing or drying, but after acquiring their sheath they are able to withstand continued and repeated freezing and will survive for many weeks in a dried condition. During wet weather and on dewy nights the ensheathed embryos crawl up stalks of grass or other convenient objects, ceasing their migrations when the humidity of the atmosphere falls below the point of saturation, usually coiling themselves into a spiral like a watch spring. They remain quiescent until the air again becomes moisture laden, when they resume their migrations, gradually working their way higher and higher. When grass thus infested is eaten by a sheep or other ruminant, the embryos continue their development, attaining full maturity in about three weeks. The foregoing facts are discussed more fully in Bureau Circular No. 93. Experiments are in progress to determine the necessary precautions to be taken in order to raise lambs free from parasites, particularly *Hæmonchus contortus*, the nodular worm (*Esophagostomum columbianum*), and the hookworm (*Monodontus trionocephalus*). So far the results of these

experiments have been very encouraging, indicating the entire feasibility of raising sheep free from the species of parasites mentioned, and more extensive experiments in various parts of the country in cooperation with State experiment stations and individual sheep owners are being planned.

#### GID IN SHEEP.

Further reports of the occurrence of the gid parasite in Montana have continued to come in since its discovery there in 1904, indicating that this dangerous parasite is becoming more prevalent in that State. In certain details the specimens of the parasite from Montana differ from specimens of European origin, and these differences, if found to be constant in all specimens, would show that the American form is of a different species or variety from that found in Europe. It is planned to investigate more fully this question of identity and to make a study of the distribution of the Montana parasite, the amount of damage caused by it, the relation of dogs and wolves to its propagation, and other points in its life history of importance from the standpoint of prophylaxis.

#### THE LARGE AMERICAN FLUKE IN SHEEP.

A destructive outbreak of fluke disease in a flock of sheep in Michigan during the winter was found to be due to the large fluke (*Fasciola magna*). While this parasite is common in cattle in various parts of the United States, it seems never to have been definitely reported in sheep prior to this time.

#### AUTOPSIES ON WILD ANIMALS.

The National Zoological Park furnishes quite an important percentage of the necropsies made by the Pathological Division. During the past year 171 animals from this source have been examined. In this collection are represented only the vertebrata, being still further limited to the series amniota. The list is pretty evenly and widely distributed among the three classes, reptilia, aves, and mammalia. If space permitted, a still further classification would be not only interesting but important for study as showing the truly comparative nature of the pathologic studies thus carried on.

The post-mortem findings reveal the following:

Not diagnosed (failure due to decomposition and other unavoidable conditions), 18; traumatisms, 5; poisoning (arsenical), 9; old age, 1; diseases, 138. Of the last number there are accredited to the digestive apparatus 52 cases, apportioned as follows:

Liver, 5 (cirrhosis, 2; fatty degeneration, 2; necrobacillosis, 1). Gastro-intestinal tract, 45 (acute indigestion, 1; gastritis, 1; gastro-enteritis, 10; gastritis and intestinal hemorrhage, 2; enteritis, 14; enteritis complicated with peritonitis, 4; infectious enteritis, 3; infectious entero-hepatitis, 1; hemorrhagic enteritis, 1; colitis, 1; ulcerative colitis, 1; gangrenous intestines, 1; intussusception, 1; intestinal parasites, 3; carcinoma of the abomasum, 1). The gastro-intestinal and respiratory tracts were involved together in 2 cases. Enteritis and pulmonary edema, 1; pneumonia and catarrhal enteritis, 8; pul-



monary edema, 1; pneumonia and pleurisy, 2; streptococcal bronchopneumonia, 1; verminous pneumonia, 1; lung parasites, 1; asphyxia, 1. The genito-urinary tract was involved 4 times—septic metritis and purulent peritonitis, 1; acute interstitial nephritis, 1; chronic interstitial nephritis, 2.

Bacterial diseases were specifically determined in the following 44 cases: Tuberculosis, 16 (pulmonary, 1; abdominal, 1; generalized, 14); infection with *Bacillus hydrophilus*, 2; with *B. proteus*, 17, including 1 case of infection with *B. proteus fluorescens*; infection with *B. enteritidis*, 2; with *B. pyoseaneus*, 1; hemorrhagic septicemia, 3; septicemia, 2; septicopyemia, 1. Mycotic disease figures six times in this list, all being cases of aspergillosis (generalized, 4, 1 by *A. flavus*, 3 by *A. fumigatus*; pulmonary, 2, both by *A. fumigatus*). There were also noted 1 case of pseudo-leukemia, 1 of double goiter, 2 of osteomalacia, and 2 of filariasis.

#### DISEASES OF BIRDS.

The routine post-mortem work on birds by the Pathological Division has furnished the usual variety of diseases, with here and there the occurrence of some rare form. Traumatism claimed 2, both cases being instances of a foreign body in the gizzard. One duck and 2 chickens came as samples of a rather extensive outbreak of food poisoning. Three deaths by impaction—1 of the crop, 1 of the intestines, and 1 of the oviduct—and 1 case of invagination of the intestine with consequent bacterial invasion of the whole body were noted among chickens. Four chickens revealed on necropsy an intestinal catarrh due to intestinal parasites, and 5 pigeons brought in at different times showed the presence of the air-sac mite. Protozoal diseases were represented by epithelioma contagiosa or chicken pox, 6 chickens, and infectious entero-hepatitis, 1 turkey and 1 peacock. There was 1 case of peritonitis in a chicken due to ruptured oviduct, and 11 cases of enteritis, 6 of which were cases of "going light," 3 due to infection with *Bacillus enteritidis*—1 duck and 2 pigeons. Contagious catarrh or roup was found in 4 chickens, and there were 5 cases of pneumonia (4 chickens and 1 canary), 3 cases of infection of chickens with *Bacteria sanguinarum*, and 3 cases of pulmonary congestion (2 parrots and 1 canary), 1 parrot being a case of colibacillosis.

A few cases deserve special mention, one by reason of its transmissibility to man, one for its peculiar interest to sportsmen, and one as an interesting pseudo-tuberculosis.

Besides tuberculosis there are two infectious diseases that quite frequently destroy parrots—colibacillosis and psittacosis, the latter being an infection with *Bacillus enteritidis*. One of the cases noted above as pulmonary congestion was in a parrot, the bacteriological examination of which revealed a colibacillosis. This infection being so prevalent among parrots, it may well be asked whether the early removal of fecal matter from the cage and the prevention of its mixture with the food may not be an important factor in prophylaxis. It is quite certain that those who keep parrots can not be too careful in the matter of cleanliness.

Of still greater importance is psittacosis, a virulently infectious

disease of parrots due to the presence of a *Bacillus enteritidis* variant. Parrots imported into France in large numbers from the South American countries have developed this disease on the voyage, many of them dying and those that reached their destination being distributed through purchase or otherwise only to sicken with the same disease, and, further, to transmit their disease to human beings who fondled them or fed them from their own mouths or who cleaned their cages.

The development and maintenance of hunting preserves has until lately received little attention in this country. Interest in hunting is on the increase, and of necessity the number of preserves of such birds as give sport to the hunter will be likewise augmented. With this massing together in large numbers of birds and animals will come an increase in disease, or at least greater attention to the diseases of game. Grouse disease has long been known and dreaded by sportsmen in England. Various causes—damp weather, parasites, etc.—were assigned to it until Klein's work was published in 1889. He demonstrated the causative relationship of a number of the colon group of bacilli to this disease. Hitherto grouse disease has not been reported in this country, but during the past year a preserve near Washington, D. C., lost great numbers of partridges, and an investigation of the disease revealed the cause to be a bacillus identical with that recognized by Klein in grouse disease.

A most interesting form of pseudo-tuberculosis in canaries was investigated. A canary fancier who had lost several birds brought two dead birds for examination. A small-sized mass of "canker" or yellowish, cheesy, pseudo-membranous exudate was found in the mouth. The spleen was enlarged to double its usual size, quite black where the original spleen tissue could still be seen, and so studded with caseous nodules as to be literally transformed into a tuberculated mass. The liver was studded with fine yellowish spots; the lungs and the kidneys were congested. Histologic examination of the tubercular organs gave an exact reproduction of Malassez and Vignal's tuberculeuse zoogleique, while there was recovered in pure culture from these organs as well as from the blood a bacterium which in plain broth grew as a streptobacillus. This bacterium proved pathogenic for mice, guinea pigs, rabbits, and pigeons by intravenous and subcutaneous injections and by inoculation on the irritated mucous membrane of the mouth. The spleen appeared to be the chief point of attack, with the liver and lungs next in the order named. The pathologic findings were identical in both canaries and in one brought in five weeks later. In this last bird the "canker" had diminished from a large mass to a minute speck under the application of weak boric-acid solution. However, unless such cases are noted very early and treated energetically, there can be little hope, as the germ appears to be quickly transferred by the lymphatics to the viscera. Streptobacillary pseudo-tuberculosis has not been noted before in this country.

During the year pulmonary mycosis in birds, which subject was comprehensively described in the Twentieth Annual Report of this Bureau, has been observed in 6 birds (2 white Indian cranes, 2 red-head ducks, 1 ibis, and 1 loon) autopsied at the National Zoological Park. In all these cases the affection appeared very extensive,

especially affecting the lungs and the air sacs. It is quite evident that the disease was contracted before the arrival of these birds at the park, as they all succumbed in from eight to twenty-five days after being received.

#### BEE DISEASES.

Since the latter part of the summer of 1905 the Pathological Division has been engaged in cooperative experiments with the Bureau of Entomology in the investigation of disease of the honey bee, especially black brood (foul brood of Cheshire and Cheyne). A considerable part of the work has consisted in diagnosing samples of diseased brood sent to the laboratory from various parts of the country. As a result of the examinations it would appear from the negative result of many of our cultures that there are a considerable number of combs in which the larvæ have died as a result of chilling or other causes, and yet the appearance of the comb to the naked eye so much resembles the appearance of black-brood combs that a positive diagnosis was rendered almost impossible without recourse to a bacteriological examination. *Bacillus alvei* was isolated from a number of cases, and new foci of the disease have been located, especially those at Queen, Pa., and Palestine, Ill. Attempts were made in a small colony over a period of several weeks to reproduce black brood through the feeding of pure cultures of *Bacillus alvei*, but they have not thus far proved successful.

A few specimens of bees affected with bee paralysis were examined bacteriologically, and while several organisms were isolated from the specimens, no one of them appeared regularly in the different cases. The nature of this peculiar malady will receive further study. Several cases of supposed foul brood were also received, and anaerobic and aerobic cultures were inoculated in media made from healthy bee larvæ, but no conclusions have been drawn from the limited amount of work done with the bacteria thus obtained.

#### EXPERIMENTS WITH DIPS AND DISINFECTANTS.

##### STOCK DIPS.

Extensive laboratory experiments have been made in the Biochemic Division during the past year with various forms of stock dips with the object of increasing the efficiency of the dips now used for official dipping, and also for the purpose of determining the value of dips not now permitted for official use. The standardization of dips which are as a rule made of crude materials is a difficult problem and will no doubt consume considerable time, but sufficient progress has already been made to lead us to hope that we may succeed in our attempts to increase the efficiency of stock dips and at the same time to decrease their cost. The laboratory experiments have progressed to such a point that practical field experiments based upon results obtained in the laboratory have already been started by cooperation of the Biochemic and Zoological Divisions with the South Dakota Agricultural Experiment Station. Specially pre-



pared dips are being tried on sheep affected with scab and are also being tested by comparing their effects upon scab mites removed from their host.

An effort has been made to modify crude petroleum so as to remove the possibility of the injury to cattle which sometimes follows the use of the plain crude oil as a dip. As a result of these experiments an emulsion was devised and subsequently described in Circular No. 89 of this Bureau. Reports from field experiments indicate that when properly prepared this emulsified oil possesses the virtue of the crude oil without its injurious properties. Further experiments with the emulsion are desirable.

#### DISINFECTANTS.

In conjunction with the dip experiments a similar line of work has also been undertaken with disinfectants. Fair progress has been made, and a detailed report of the results will soon be submitted for publication. The experiments have so far been directed chiefly toward the determination of the relative value of cresol-soap solutions and carbolic acid as germicides, and they point very clearly to the fact that cresol-soap solutions containing cresol in fixed proportions are more efficient germicides than carbolic acid in equal strength.

#### MISCELLANEOUS ZOOLOGICAL WORK.

##### PARASITES OF POULTRY.

The various species of tapeworms occurring in poultry in this country have been studied by the Division of Zoology, and a circular (No. 85) has been issued fully describing these forms and giving directions for treatment and prevention. Other parasites of poultry, some of them species new to science, have been studied, and the results are now being prepared for publication.

##### TICKS.

The study of the habits and life histories of ticks has been continued. Some unusual host relations of the Texas fever tick (*Boophilus annulatus*) were investigated and will be described in an article soon to be published. Some experiments with the chicken tick (*Argas miniatus*) were begun during the summer of 1905, with the special view of determining its relation to the so-called "tick disease" of chickens in the South, which is probably identical with the tick-borne spirillosis of South American chickens.

##### COLLECTION AND IDENTIFICATION OF PARASITES.

A large number of parasites have been collected at the autopsies of various domestic and wild animals, and numerous specimens sent in by correspondents have been identified.

## INDEX-CATALOGUE OF MEDICAL AND VETERINARY ZOOLOGY.

The work on the card index has been continued during the year, and five parts of the Index-Catalogue of Medical and Veterinary Zoology, Bulletin 39, comprising the K and L authors, have been published.

**SUPERVISION OF PEDIGREE RECORD ASSOCIATIONS.**

A radical change has been made in the regulations of the Government regarding the importation of animals for breeding purposes. Heretofore the pedigree certificate of animals imported for breeding purposes had to show registration of sires and grandams. This requirement caused endless complaint from importers, and has been maintained only because the Department felt that in no other way could there be a reasonable assurance of pure breeding. Without a closer supervision of the books of record a more lenient requirement would be impracticable.

To improve the situation the Bureau considered the advisability of placing on the American herdbook secretaries the responsibility for the pure breeding of animals imported for breeding purposes, and requiring registration in an American book of record as the only evidence necessary to pass a breeding animal through the customs free of duty. Before taking definite action, however, the sentiment of the secretaries of American pedigree record associations was ascertained, and it was found that the great majority of them were in favor of such a change. Accordingly Bureau of Animal Industry Order No. 130 was revised and replaced with Bureau of Animal Industry Order No. 136, to take effect July 1, 1906. The new order requires all animals imported for breeding purposes to be registered in an American book of record before free entry will be permitted. The certificate of a custodian of such book of record that the animal is purebred and has been registered is all that is necessary for free entry. Where a breed has no book of record in the United States, the certificate of the Chief of the Bureau of Animal Industry must be obtained before the animals are passed free. A herdbook assistant to the Animal Husbandman of the Bureau has been appointed to devote his entire time to the work of supervising the certified American associations and the examination of pedigrees submitted to the Bureau for approval.

This change is a very important one and should result in good to the breeding industry. It will not only make secretaries more careful in the registration of imported animals, but will compel importers to register such animals, which has not been done in all cases, particularly with horses. If an imported animal is not registered, the breeding of its progeny is difficult and often impossible to establish, and therefore the intent of the law is nullified. But little objection has come to the Department from importers, and this has been largely from importers of horses, who claim that the fact that horses are not quarantined will make it difficult to get American certificates to the port of entry as soon as importations land; but this difficulty can probably be readily remedied. An importer can mail his foreign certificates to the American secretary far enough in advance of sailing

to allow that officer time to record them and issue his own certificates and get them to the importer on landing.

The other features of the former regulations (Bureau of Animal Industry Order No. 130) are retained in substantially the same form.

The following numbers of books of record were on the certified list July 1, 1906:

	American books of record.	Foreign books of record.
Cattle .....	14	24
Horses .....	19	22
Asses .....	1	.....
Sheep .....	20	13
Hogs .....	12	2
Dogs .....	1	4
Cats .....	2	1
Total .....	69	66

### BREEDING INVESTIGATIONS.

#### HORSE BREEDING.

The horse-breeding work at the Colorado Experiment Station is progressing very satisfactorily. The stallion Carmon was bred to 26 mares in 1905, and got 24 in foal at the first service. His first crop of foals came last spring, and, while it is too early to pass an opinion on them, it can be said that they prove the horse to be a good investment as a sire. The stud has been increased by the purchase of two mares in Kentucky—one an inbred Mambrino King mare, and the other by Chester Dare out of a daughter of Harrison Chief. We have already some Harrison Chief blood among the mares in Colorado, but this is the first introduction of that of Mambrino King, unless the claim can still be made that Mambrino King was a grandson of Mambrino Chief, whose blood we have in considerable abundance. The female line from Harrison Chief is one of the most valuable known for the production of quality, style, and good conformation, and Mambrino King was one of the handsomest horses ever seen in an American show ring. For these reasons these mares should be of great value in the breeding work.

These purchases should be followed by others. There are probably a number of mares in the Colorado stud which will have to be discarded eventually as unfit for breeding purposes, and these should be replaced by others. Further, 20 mares is too small a number with which to do satisfactory work. The number should be increased. The experiment in breeding carriage horses has attracted the attention of the entire country and has caused much interest in the intrinsic value of the American horse. The Department has started a line of work which it is believed will be of the greatest value to American stockmen, and it should follow it up systematically and thoroughly. It is not the intention to recommend that the work should be increased to a point where it may become burdensome to the station, but the Department should be ready to purchase exceptionally good mares as opportunity offers, even if the number is increased beyond 20.

Work in breeding Morgan horses, in cooperation with the Ver-



mont Experiment Station, was begun in June with the purchase of 7 mares and 2 fillies in Vermont and 2 mares in Kentucky. The object of this work is to prevent the loss of the Morgan blood and preserve the type, at the same time increasing the size over that of the old Morgan. The mares were bought by a board composed of Prof. C. F. Curtiss, director of the Iowa Experiment Station; Mr. Cassius Peck, of the Vermont Experiment Station, and Mr. George M. Rommel, the Animal Husbandman of this Bureau. The board was very fortunate in securing mares of good size, uniformity, and quality, and strongly bred in Morgan line. The mares purchased in Vermont were sired by General Gates, Denning Allen, Bob Morgan, Young Ethan Allen (a full brother of Daniel Lambert), Rocky Mountain, and Gillig. Those bought in Kentucky were sired by Harrison Chief out of Morgan dams, and give a combination of blood lines which is of the greatest value.

The extension of the work in horse breeding is a matter of the highest importance. In Vermont it is doubtful whether the resources of the station will permit an extension beyond what will come from the natural increase of the stud. In Colorado, however, the station is anxious to increase the number of mares materially, and the sentiment of the stockmen of the State is in harmony with the station's attitude.

A more important extension can and should be made by establishing experiments in Kentucky. Nowhere can the same amount of useful and valuable material be found. It is the center of the light horse breeding industry of the country; more carriage horses come from there than from any other State in the Union, and the project to establish a breed of American carriage horses will never be complete until the advantages of Kentucky are realized. The importance of this step warrants an increase in the appropriation for this purpose.

#### BREEDING ZEBRA HYBRIDS.

Unfortunately no progress whatever has been made in the breeding of hybrids between the Grévy zebra and the mare. The Zoological Park has not been able to breed the large zebra to mares, and a younger male, presented to the Department by Ras Makonnen, governor of Harrar, Abyssinia, through the courtesy of Hon. R. P. Skinner, consul-general at Marseille, broke his neck the first day he was turned out last spring by running into a woven-wire fence. The consent of the President has been obtained to use the large Grévy zebra at the Bureau Experiment Station. Quarters are being arranged and will soon be ready for occupancy.

#### FECUNDITY OF POLAND-CHINA AND DUROC-JERSEY SOWS.

An investigation of the fecundity of Poland-China sows was made by the Animal Husbandman of the Bureau, and the results were published in Circular No. 95 of the Bureau series. A similar investigation of the fecundity of Duroc-Jersey sows was included.

Results for Poland-Chinas were compiled from the American and the Ohio (now the National) Poland-China Records for the years 1882-1886 and 1898-1902. The total number of litters for the earlier period was 14,703 for the two records combined, and for the later

period 39,812. The average number of pigs per litter for the earlier period was found to be 7.04 and for the later period 7.52, an increase of 0.48 per litter. The increase was somewhat greater in the American Poland-China Record than in the Ohio. These results are contrary to popular opinion regarding this breed, and show that the charges of diminishing fecundity are without warrant when a comprehensive number of litters is considered. They also show the value of the system used by the hog breeders' associations in requiring breeders to report the number of pigs farrowed in each litter, as it gives breeders data with which to increase the fertility of their herds.

The records for Duroc-Jersey sows could not be compiled for so long a period of time, only ten years being available with a comprehensive number of litters. The first five years (1893-1897) show an average size litter of 9.22, and the five-year period 1898-1902 an average size of litter of 9.27. The results for 1893 seemed to be abnormal, and if omitted there is a decrease of 0.01 per litter, too small to be of practical value. The results confirm popular opinion that Duroc-Jersey sows are more prolific than Poland-Chinas.

These investigations are being followed with studies of the inheritance of fecundity. Some results have already been obtained which show that the size of litter is affected, in part at least, by maternal inheritance and that the size of litter increases with the age and maturity of sows.

#### POULTRY BREEDING.

The cooperative investigations in poultry breeding at the Maine and Rhode Island experiment stations have been continued during the year. In Maine the principal object is to increase the egg-laying capacity of the flock of chickens. Already several hens have been found to lay more than 200 eggs in one year, and the results seem to indicate that the average egg yield of a flock can be increased by selection. A bulletin describing the methods used and the results so far obtained in this work has been prepared for publication.

In the Rhode Island experiments an effort is being made to breed turkeys that will be resistant to the disease commonly known as blackhead.

#### BREEDING EXPERIMENTS WITH SMALL ANIMALS.

Arrangements have been made to begin investigations in animal breeding by collaboration between the Animal Husbandry Office and the Experiment Station of the Bureau, using for this work the large stock of guinea pigs, rabbits, and other small animals at the station. Experiments to determine the effects of inbreeding will be started at once, and studies will later be made of crossbreeding.

#### FEEDING INVESTIGATIONS.

##### COOPERATIVE INVESTIGATIONS IN ANIMAL NUTRITION.

Investigations in animal nutrition in cooperation with the Pennsylvania Experiment Station were undertaken in 1898, when the construction of a respiration calorimeter for domestic animals was begun. The completion of this large and complicated apparatus occupied

fully three years, the first experiments with animals having been conducted in the winter of 1901-2 and work having been continued up to the present time. These investigations are in charge of Prof. H. P. Armsby, director of the Pennsylvania station.

The investigations constitute a careful, scientific study of the fundamental principles of animal nutrition. Starting with the food as a source of energy to the animal machine, they follow this energy through to its ultimate effect, determining how much escapes in the undigested residues of the food, how much is expended in the digestion and assimilation of the food, and what surplus remains to sustain the life of the animal or enable it to produce meat, milk, or work. The investigations are complicated, requiring the services of not less than seven men for the actual conduct of an experiment, and involve in addition a large amount of laboratory work and extensive computations. Hence it is not strange that the results seem slow in accumulating. The results thus far published include experiments upon timothy hay, red-clover hay, and corn meal, as to their relative values both for maintenance and for productive purposes. An outline of the results obtained has been published in Bulletin No. 74 of the Bureau of Animal Industry and in Bulletin 71 (revised) of the Pennsylvania station.

More important than the mere numerical results, however, has been the aid which the experiments have afforded in clearing up some fundamental points regarding the energy relations between the food and the animal. At the time when these investigations were begun the prevailing ideas were based largely on Rubner's earlier investigations, which were popularized in the United States by the writings of Atwater. It was then supposed that the so-called "fuel values" of feeding stuffs—that is, the amount of heat which they were capable of giving off in the body—was a measure of their nutritive value, and Rubner's factors for the fuel values of human food were used quite generally to compute the fuel values of the digestible nutrients of stock foods, a proceeding natural enough at that time, but which unfortunately seems to have proved less susceptible to change than the ideas on which it was based.

The investigations of Kellner in Germany and those at the Pennsylvania Experiment Station have amply demonstrated that this conception was erroneous, and that the real values of stock feeds are much less than their fuel values. That this should be true in the fattening or milk-producing animal is not so surprising, but that it should prove to be the case on a simple maintenance ration compels a material modification of our general conceptions and is of fundamental importance to the theory of the subject. The Pennsylvania experiments have shown, in the first place, that the real fuel values of stock feeds are less than the computed ones, and that, moreover, but a fraction of the real fuel value of stock feeds is utilized for any purpose in the body. In the three cases thus far investigated the real values for maintenance were found to range from 56 per cent of the fuel value computed from the digestible nutrients in the case of timothy hay to 67 per cent in the case of corn meal. On the basis of the digestible nutrients, 174 pounds of timothy hay appeared to be equal to 100 of corn meal for maintenance, while in reality 211 pounds were required. For fattening the discrepancy was still



greater, 275 pounds of timothy hay being required to equal 100 of corn meal.

A series of experiments, designed to study what effect the age and breed of the animal has upon the percentage of food energy utilized, has now been in progress for two years, but the results are not yet sufficiently complete for publication. Later it is hoped that more extended data regarding the actual values of other feeding stuffs may be secured.

#### FEEDING COTTON-SEED PRODUCTS TO HOGS.

Experiments in feeding hogs with cotton seed and cotton-seed meal have been conducted at the quarantine station at Halethorp, Md., during the year by the Animal Husbandry Office, in collaboration with the Pathological and Biochemic Divisions, to test the poisonous qualities of these feeds. Hogs have been killed with cotton seed, cotton-seed meal which had been cooked, and ordinary choice commercial meal. When a varied ration was given in addition to cotton-seed meal death did not result so soon as where only one grain was fed. Bran and middlings were found to be little better than corn meal. Experiment-station results with corn meal have been confirmed, hogs dying in about four weeks from the time feeding cotton-seed meal commenced.

Post-mortem examinations developed the fact that many of the hogs die with very constant and characteristic lesions of the internal organs, viz, a severe hemorrhagic gastro-enteritis, congestion of the liver with parenchymatous degeneration, edema of the lungs, cloudy swelling of the kidneys, and oftentimes a well-marked dropsical effusion in the pectoral and peritoneal cavities, and occasionally in the pericardial sac. This effusion is occasionally light red in color and in most cases contains fibrinous shreds which cling to the visceral organs. The edema of the lungs is a very constant and marked lesion. Ulcerations or erosions of the gastric and intestinal mucosa are seen in the severest cases, and in long-standing cases emaciation is quite noticeable.

The experiment with bran and middlings will be repeated, and tests with fermented meal will be begun.

The Bureau is now in a position to raise its own hogs for this work, which will be a great advantage. Seven sows were bred last spring, the Maryland Experiment Station courteously giving the use of its herd boar. The Bureau has bought a boar pig, which will be used this fall, and a large number of sows will be bred.

#### BEEF PRODUCTION IN THE SOUTH.

The work in beef production in cooperation with the Alabama Experiment Station has been broadened by taking up collaborative work with Mr. John S. Kernachan, of Florence, Ala., who owns a large farm on the Tennessee River and for some years has been grading up from native cows by means of purebred Angus bulls. The experiment station is keeping records of his herd, under the direction of the Bureau, and undoubtedly good results can be obtained for southern farmers by showing the possibilities of beef production under farming conditions.

## DIGESTION EXPERIMENTS WITH POULTRY.

The feeding portion of the second series of digestion experiments with chickens, conducted by the Biochemic Division, was practically completed during the previous fiscal year, but the analytical chemical work required by the experiments was very great and has only recently been finished. The results should be ready for publication within a few months.

This second series comprises thirty-six individual experiments with corn, oats, and wheat, fed singly and in combination with each other, as well as with green feed.

## WORK IN THE INTEREST OF THE DAIRY INDUSTRY.

During the year the work of the Dairy Division has been systematized and subdivided as follows: Butter investigations, market milk investigations, cheese investigations, southern dairy investigations, building and management investigations, laboratories, inspection of renovated-butter factories, and inspection of renovated butter in the markets. Each of these lines of work has been placed under the direction of an expert, the chief of the division, Mr. Ed. H. Webster, being personally in charge of the butter investigations, and the assistant chief, Mr. C. B. Lane, of the market milk investigations.

## BUTTER INVESTIGATIONS.

In the latter part of the fiscal year 1905 plans were laid for extended investigations in the manufacture and storage of butter, with the object of rendering practical assistance to the butter-making industry by solving some of the difficulties encountered in the trade. This work was begun in June, 1905, and the first series of experiments continued throughout the fiscal year 1906. These experiments consisted in carrying in cold storage for several months, under varying conditions of temperature and storage, butter made under different conditions. The butter—about 5,000 pounds—was made at Monticello, Iowa, and Topeka, Kans., and placed in storage in Chicago, and was examined and scored during and at the end of the storage period.

Some of the questions as to which these tests were expected to give results were (1) the effect of pasteurization, (2) the amount of salt to be used, (3) temperature of storage rooms, (4) the use of cans hermetically sealed for storing butter, (5) the keeping quality of good compared with poor butter, and (6) the action of air in contact with butter in storage.

The butter was made from five lots of cream, three of which were sour when received at the creamery and two sweet. From each lot of cream two lots of butter were made, one pasteurized and the other unpasteurized, and part of each lot of butter was lightly salted and part heavily salted. The butter was packed in tubs and cans, some of the cans being only partly filled, so as to test the effect of air. It was then stored at temperatures—10°, +10°, and +32° F., and at variable temperatures, part of each lot being stored at each temperature. The butter remained in storage about eight months.

The results showed that butter containing low percentages of salt kept better than butter of the same lot containing higher percentages of salt. Butter in full cans and in tubs at the lower temperatures scored about the same. At the higher temperature there was a slight difference in favor of cans. Butter in full cans kept better than that in cans only partially full. On the whole, butter held at the lowest temperature kept best, both when in storage and after removal from storage. Butter made from cream received sweet kept well while stored at the two lower temperatures, and also after removal from storage, giving results wholly satisfactory. Butter made from cream received sour also kept well at the lower temperatures, but deteriorated rapidly after removal from storage, giving, on the whole, results which were very unsatisfactory. The conclusion is that light salting and low temperatures and the use of cream received at the creamery in a sweet condition give much the best results for storage butter.

A report giving the details of this experiment has been published as Bulletin No. 84 in the Bureau series.

The second series of experiments in the manufacture and storage of butter, which has not been completed, consists in the making of a quantity of butter at the Wisconsin Experiment Station and its storage in Chicago. Arrangements were made for the use of the Wisconsin station laboratories for the necessary bacteriological and chemical work.

Another unfinished line of work is the investigation in northern Wisconsin and Minnesota of the cause of fishy flavor in butter. The development of a fishy flavor in butter has been a source of trouble, and whenever reports were received that creameries were having this trouble an investigation was made with a view to discovering the cause, if possible.

A temporary laboratory was established at Bloomer, Wis., and large numbers of cream samples were tested bacteriologically and test churnings of butter made. While the cause of the fishy flavor has not yet been discovered, a number of probable causes have been eliminated, and a good foundation has been laid for continuing the work during the coming year.

Incidental to the last-mentioned investigations, studies were made of the cause and methods of prevention of mold in butter tubs. Experiments were conducted at points in Minnesota and Wisconsin and continued at the Iowa Experiment Station. Coating the tubs with paraffin was found to be the best method of prevention. A report of these researches has been written and will soon be published.

A study of the conditions that existed in the market regarding the sale of butter convinced the officers of the Dairy Division that something should be done to assist the butter makers in producing a better quality of butter than seemed to be finding its way to the markets. The work done by the State dairy and food commissioners and their field men indicated very strongly that there was such a need. Inspectors of the Dairy Division would visit a creamery and perhaps find everything apparently all right; they would see only the fresh butter. When this butter reached the markets, however, some ten days or two weeks later, it was very often found to be defi-



cient in some respect. In order to bridge over this gap which seemed to exist between the factory inspection and the receipt of the butter on the market, an inspector was appointed in April to examine the poorer qualities of butter entering the New York market. This work was begun as an experiment to determine if some assistance could not be rendered to the creameries by giving them exact information as to the condition of their butter on its arrival in the market. The work proved so advantageous that the butter board in Chicago requested the appointment of a similar officer for that market, and this request has been complied with. A system of reporting has been organized by which a statement of the condition of the butter is sent to the butter maker, a copy of it filed with the butter dealer who purchases this butter, and another copy sent to the office of the dairy and food commissioner of the State in which the creamery is located, for the use of his field inspectors. The dairy and food departments, particularly in Michigan, Minnesota, and Iowa, have indicated their desire to cooperate with the Federal Department of Agriculture in making this work a complete success.

#### CHEESE INVESTIGATIONS.

The investigations in the manufacture of soft cheese at Storrs, Conn., in cooperation with the Storrs Experiment Station, have been continued throughout the year. During the winter Dr. Charles Thom, mycologist connected with this work, spent two months abroad studying the manufacture of cheese in England, France, Germany, Switzerland, and Italy, and these studies have resulted in marked progress in the investigations concerning the manufacture of Camembert and Roquefort cheese. A bulletin (No. 82) dealing with the fungi which have to do with the ripening of these cheeses was issued during the year. The knowledge so far gained of these fungi and of the methods used and the conditions necessary in the manufacture of such cheeses indicates that it will be practicable to produce in this country soft cheeses of these types fully equal to the best European product, tho there are some problems yet to be studied.

A study was made of the conditions surrounding the manufacture, storage, and sale of American Cheddar style cheese throughout the cheese manufacturing section of the country. During these investigations a locality was selected in which to make cheese for experimental curing and storage. A satisfactory place was found at Plymouth, Wis., where storage rooms suited to the needs of the work were secured, and a cheese factory about 3 miles from the town was induced to cooperate with the Dairy Division in the manufacture of cheese for storage. Mr. C. F. Doane, expert in charge of cheese investigations, spent three months in the summer of 1905 at this place, making cheese and studying the conditions in that part of Wisconsin. Between 2,000 and 3,000 pounds of cheese were placed in storage under different conditions of make and storage temperature.

In these experiments the usual amount of rennet, 3 ounces to 1,000 pounds of milk, was used for one-half of the cheeses, and twice the amount, or 6 ounces of rennet to 1,000 pounds of milk, was used for the other half. Two cheeses of each day's make were stored immediately in the curing room having a temperature of 32° F., two in

the curing room at 40° F., and two were cured in the factory curing room at about 65° F. Other cheeses were held one week to two weeks after making and were then stored at 32° and 40° F. In the case of both the low-rennet and the high-rennet cheese, that cured at 32° F. directly from the press scored highest, the average being 95 and 94.4 points, respectively, out of a possible 100. The cheese scoring lowest in each case was that cured entirely in the factory curing room at about 65° F. It was also shown in these investigations that taints develop more noticeably in the factory curing room than in cold storage, and that taints and acidity were checked more by storage at 32° F. than at 40° F. It appears also that cold curing derives its value chiefly from its effect on what otherwise might be poor cheese. In view of the growth of the popular taste toward mild cheese it appears that the time is soon coming when all cheese, if ripened at all, must be ripened at low temperatures, and the sooner it is put into cold storage the better.

The details of these experiments, together with a digest of previous work on the same subject, have been published in Bulletin No. 85 of this Bureau. There was also published during the year a report on experiments in cold storage of cheese conducted by the Dairy Division in 1903-4.

The work at Plymouth and vicinity showed the need of a much larger and more comprehensive study into the methods of manufacture, ripening, and storage of American Cheddar style cheese, and toward the close of the year arrangements were made with the Wisconsin Experiment Station at Madison for cooperative work of this character, the station to furnish the services of an expert chemist and of an experimental maker. Cheese will be purchased on the open market and placed in storage, and cheese manufactured under known conditions will be placed in storage.

The Dairy Division is cooperating with the Office of Experiment Stations of the Department in investigations as to the digestibility of Cheddar style cheese. The work has been conducted at Middletown, Conn., and will be continued for another year. It is hoped that these investigations will have a practical bearing upon the use of cheese as a food by the American people.

#### MARKET MILK INVESTIGATIONS.

During the year a study of the various markets was made and a bulletin was published on "The Milk Supply of Boston, New York, and Philadelphia." Investigations and studies were also started concerning the production, delivery, and distribution of market milk and the organization and working of milk sanitary commissions and other organizations tending to improve the quality of market milk. Plans are under way for organizing some system of scoring and registering dairies.

During the National Dairy Show in Chicago in February the Dairy Division conducted an exhibit of milk and cream. Samples were secured from 13 different States and from 45 different producers. Medals were awarded by the show association, and diplomas were given by the Department of Agriculture, for the exhibits which scored highest and kept best. This work attracted a great deal of attention

and has stimulated a desire in a number of States to inaugurate systems of scoring milk and cream. A report has been prepared for publication as a bulletin of the Bureau.

During the year circulars were sent out to about 2,500 American cities asking for information concerning the milk supply and the regulations governing the distribution and sale of milk. About 1,400 replies were received, containing a great deal of material that will be useful in advancing the cause of good milk.

#### SOUTHERN DAIRY INVESTIGATIONS.

The first work in connection with the investigations of southern dairying was to make a careful survey of the present conditions in the South. With this in view various States were visited by Mr. B. H. Rawl, who is in charge of this work, and conditions existing in the towns and surrounding country were studied. Ample notes of these conditions were taken with a view to determining the best course for future work to improve conditions and promote the dairy interests.

This preliminary work has developed the following facts: In some cases herds were found producing as good results as are ordinarily expected in any section of America. At other places milk was produced as cheaply as in any dairy section in the country. On the whole there was an enormous demand for dairy products. Almost all butter and cheese was obtained from other sections, some cream being shipped a great distance. Condensed milk and cream find a great market throughout all the southern cities. Silage is used to a very limited extent in the South, but in a few isolated cases silos were found to contain an excellent quality of silage. One of the great drawbacks to dairying in the South is the inferior grade of cattle found there. They are mostly descendants of the Jersey breed, but lack altogether any quality that characterizes that breed. It is probable that this poor quality of dairy stock is due, in large part, to the fact that the live-stock industry has been made unprofitable because of the presence of the cattle tick and the infection of Texas fever. The southern dairyman does not know how to grow feeds cheaply for dairy feeding. In many cases the feeds that he has at hand are not used to advantage because of lack of knowledge of the proper feeding methods. There is great need throughout the South for education in improved methods of dairy breeding and feeding and milk production.

The investigations so far have shown that there is a great desire on the part of many southern people to know more about dairying. They are anxious for something that will enable them to get away from the one-crop system. The action of Congress in appropriating \$20,000 for the extension of this work during the fiscal year 1907 indicates that its importance is beginning to be realized.

#### DAIRY BUILDING AND MANAGEMENT INVESTIGATIONS.

The large number of inquiries that come to the Dairy Division for assistance in designing and constructing modern improved dairy barns and other dairy buildings resulted in the taking up of the study



of buildings of this character. Circulars were issued stating that the Division was prepared to give assistance to a limited number of applicants for plans for barns and other dairy buildings, and many inquiries were received as a result. A large number of plans have been worked out and sent to farmers throughout the country. More have been sent to dairymen in the South than to any other section, though applications have come from every State in the Union.

The subject of silo construction has also received considerable attention. In August, 1905, three silos, representing three distinct types of construction, were built on different farms in the same neighborhood at Easley, S. C. They were built by the owners under the supervision of the Dairy Division. One of these silos was of an entirely new form of construction, originated by Mr. G. H. Parks, the Division architect, which it is believed will prove to be very satisfactory. It consists of expanded metal, of a gage sufficiently strong to withstand the pressure of the silage, and cement. The sheets of expanded metal were nailed to temporary studs and the lapping ends securely wired together. The inside was then plastered with 2 inches of cement and the temporary studs removed, after which the outside was covered with about one-half to 1 inch, completing a wall from  $2\frac{1}{2}$  to 3 inches in thickness. As the silo was only partially filled the first winter, no conclusions as to the reliability of this construction have been drawn.

Another of these silos was built on what is known as the modified Wisconsin plan, which is described in publications of the Wisconsin Experiment Station and of many other stations. The third silo is known as the stave silo. In the latter a slight departure from the regular method of construction was made. The staves were spiked to each other at intervals of about 5 feet, so that the structure stood solid and firm even before the hoops were placed upon it. It is believed that this method of spiking the staves together is superior to the old method of putting up tongued and grooved staves.

It is the intention to study these three forms of silo as to their durability and practicability. Applications were received during the year for specifications and directions for building more than 75 silos in the South.

A circular (No. 90) giving a plan for a modern dairy barn, with suggestions that would enable a builder to use the ideas embodied in this structure in any form of barn he might wish to build, was issued during the winter and a large number of copies were distributed at the dairy show in Chicago in February. This circular was copied by nearly all the agricultural papers of the country and received favorable comment. Plans are gradually being worked out for a more complete publication concerning barn and silo construction.

Investigations into the management of creameries and cheese factories are being undertaken. The principal creamery and cheese sections of the country will be visited and the business features of the industries studied, including the organization of the creamery or cheese factory company, the equipment of such establishments, the kinds of buildings used, etc. The object of this line of work is to enable the Dairy Division to give expert information along these lines to those who desire it.

## DAIRY LABORATORIES.

The Dairy Division has not heretofore maintained a dairy laboratory in Washington, the necessary laboratory work having been done in other laboratories of the Department or at experiment stations. It was decided, however, in the latter part of the fiscal year to establish a laboratory for the Dairy Division in Washington, and two rooms of the building used by the division were set aside and are being fitted up for this purpose.

## RENOVATED BUTTER INSPECTION.

The inspection of renovated butter and of the factories producing the same, under the law of May 9, 1902, has been continued. During the twelve months ending June 30, 1906, 374 inspections were made at 67 factories, making an average of  $5\frac{1}{2}$  visits to a factory, the greatest number of inspections made at any one factory being 9. These factories produced during the fiscal year 53,795,321 pounds of renovated butter, as against 60,164,783 during the previous year. During the fiscal year 1906 the following amounts of renovated butter were inspected for export: At Chicago, 6,353,881 pounds; at New York, 4,184,118 pounds, and at Boston, 467,538 pounds, a total of 11,005,537 pounds.

The general sanitary condition of factories has improved materially from past years, and there are fewer violations of regulations in regard to the affixing of labels and stamps as prescribed by the law and the regulations of the Department. As a rule the factory men are endeavoring to the best of their ability to comply with the law and the regulations.

Renovated butter has also been inspected in the markets with a view to detecting violations of the law and regulations. On evidence obtained by inspectors two prosecutions were brought against a dealer, which resulted in his conviction in both cases, a fine being imposed in one and both fine and imprisonment in the other. The court decisions sustained the rules and regulations of the Department of Agriculture in so far as they applied to the cases in hand.

Samples were collected in a number of cities where renovated butter was found to be sold in an illegal manner, and cases have been prepared for prosecution against two wholesale dealers in renovated butter for removing the marks, stamps, labels, etc., and putting the goods on the market under deceptive names. These cases have not yet been brought to trial. It is believed, however, that there will be no further question as to the right of the Department to control the way in which renovated butter shall be sold upon the open market, so as to prevent fraud upon the purchaser and the consumer.

## FUTURE DAIRY WORK.

The lines of work already under way should be continued and several of them extended. For instance, it is proposed to take up the study of Swiss cheese in addition to the other European varieties now being investigated, and the southern dairy investigations should be enlarged as the work progresses. The building and management investigations have only begun.

The Dairy Division has been able to make but little headway during the year toward indexing dairy literature as proposed in the report for the previous year, but plans are made for carrying out the project. A comprehensive index of dairy literature would be of great value and assistance in the work of the division and to dairy writers and investigators, as there is no such index in existence.

The efforts of the Dairy Division so far have been mainly along the line of the handling and marketing of milk and the manufacture of milk products. The whole subjects of dairy husbandry, the production of milk, the influence of breed and feed on quality and quantity of milk, the encouragement of farmers to know more about their stock, and other important lines of work, are as yet untouched by the division, except that a beginning has been made for the year 1907 in the study of milk as it may be affected by the period of lactation and the breed of the cow.

Two new lines of work are planned to be undertaken during the fiscal year of 1908, namely, investigations in milk production and in the manufacture of condensed milk and cream.

In order to extend the present work and to take up the new lines of work that are indicated, a considerable increase in the amount of appropriation available for the Dairy Division will be necessary.

#### **PUBLICATIONS.**

Several of the publications issued or prepared during the fiscal year have already been mentioned. Besides these, the Twenty-first Annual Report of the Bureau for 1904 was issued, and the Twenty-second Annual Report (1905) was prepared for publication. These annual reports are volumes of several hundred pages, containing special articles and miscellaneous information relating to the live-stock industry and the work of the Bureau. Among other important publications prepared during the year are a bulletin on Tuberculosis of the Food-producing Animals, by Dr. D. E. Salmon (this work having been undertaken while he was Chief of the Bureau and only recently completed), and a revision of Bulletin No. 27, Information Concerning the Angora Goat, made in pursuance of a resolution of Congress.

The new publications issued by the Bureau during the twelve months ending June 30, 1906, were 70 in number, consisting of the Twenty-first Annual Report of the Bureau, the annual report of the Chief, 13 bulletins, 19 circulars, 3 Farmers' Bulletins, 31 orders and regulations, and 2 Yearbook papers, aggregating 2,099 printed pages.

#### **NEEDS OF THE BUREAU EXPERIMENT STATION.**

The work required of the Experiment Station has increased until the facilities, both as to laboratory and field room, have become inadequate. The addition of a second story to the laboratory building is greatly needed, and there is some doubt as to whether the current appropriation act confers authority for such work or for the erection of new structures of any kind. More land is also needed, not only to allow room for the proper arrangement and separation of animals under experiment with contagious diseases, but to provide for the production of green forage for the animals, which are necessarily con-



fined to small paddocks. Increased space would lessen the danger of the accidental spread of contagion as well as effect a large saving in feed bills, and the purchase of additional land is therefore considered the part of wisdom and economy. I recommend that Congress be asked for authority for such purchase, also for authority to make alterations to existing buildings and to erect new structures as necessity may arise.

#### **PROPOSED EXPERIMENTAL FARM FOR BREEDING, FEEDING, AND DAIRY INVESTIGATIONS.**

As the work in animal breeding and feeding progresses, it becomes evident that the Bureau will need an experimental farm near Washington for investigations of this class, aside from the cooperative work being done with the State experiment stations. Experiments in breeding and feeding have been carried on in a small way at one of the Bureau quarantine stations and at the Bureau Experiment Station for contagious diseases, but it is obviously very undesirable and unwise to keep animals for experiments of this kind on the same premises where animals are undergoing quarantine or where experiments are being made with contagious diseases. It therefore seems that the time is soon coming when the Bureau should be provided with a separate farm for investigations in breeding and feeding live stock and in dairying.

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### **APPENDIX.**

#### **THE MEAT INSPECTION AMENDMENT—APPROVED JUNE 30, 1906.**

That for the purpose of preventing the use in interstate or foreign commerce, as hereinafter provided, of meat and meat food products which are unsound, unhealthful, unwholesome, or otherwise unfit for human food, the Secretary of Agriculture, at his discretion, may cause to be made, by inspectors appointed for that purpose, an examination and inspection of all cattle, sheep, swine, and goats before they shall be allowed to enter into any slaughtering, packing, meat-canning, rendering, or similar establishment, in which they are to be slaughtered and the meat and meat food products thereof are to be used in interstate or foreign commerce; and all cattle, swine, sheep, and goats found on such inspection to show symptoms of disease shall be set apart and slaughtered separately from all other cattle, sheep, swine, or goats, and when so slaughtered the carcasses of said cattle, sheep, swine, or goats shall be subject to a careful examination and inspection, all as provided by the rules and regulations to be prescribed by the Secretary of Agriculture as herein provided for.

That for the purposes hereinbefore set forth the Secretary of Agriculture shall cause to be made by inspectors appointed for that purpose, as hereinafter provided, a post-mortem examination and inspection of the carcasses and parts thereof of all cattle, sheep, swine, and goats to be prepared for human consumption at any slaughtering, meat-canning, salting, packing, rendering, or similar establishment in any State, Territory, or the District of Columbia for transportation or sale as articles of interstate or foreign commerce; and the carcasses and parts thereof of all such animals found to be sound, healthful, wholesome, and fit for human food shall be marked, stamped, tagged, or labeled as "Inspected and passed;" and said inspectors shall label, mark, stamp, or tag as "Inspected and condemned," all carcasses and parts thereof of animals found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food; and all carcasses and parts thereof thus inspected and condemned shall be destroyed for food purposes by the said establishment in the presence of an inspector, and the Secretary of Agriculture may remove inspectors from any

such establishment which fails to so destroy any such condemned carcass or part thereof, and said inspectors, after said first inspection, shall, when they deem it necessary, reinspect said carcasses or parts thereof to determine whether since the first inspection the same have become unsound, unhealthful, unwholesome, or in any way unfit for human food, and if any carcass or any part thereof shall, upon examination and inspection subsequent to the first examination and inspection, be found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food, it shall be destroyed for food purposes by the said establishment in the presence of an inspector, and the Secretary of Agriculture may remove inspectors from any establishment which fails to so destroy any such condemned carcass or part thereof.

The foregoing provisions shall apply to all carcasses or parts of carcasses of cattle, sheep, swine, and goats, or the meat or meat products thereof which may be brought into any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, and such examination and inspection shall be had before the said carcasses or parts thereof shall be allowed to enter into any department wherein the same are to be treated and prepared for meat food products; and the foregoing provisions shall also apply to all such products which, after having been issued from any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, shall be returned to the same or to any similar establishment where such inspection is maintained.

That for the purposes hereinbefore set forth the Secretary of Agriculture shall cause to be made by inspectors appointed for that purpose an examination and inspection of all meat food products prepared for interstate or foreign commerce in any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, and for the purposes of any examination and inspection said inspectors shall have access at all times, by day or night, whether the establishment be operated or not, to every part of said establishment; and said inspectors shall mark, stamp, tag, or label as "Inspected and passed" all such products found to be sound, healthful, and wholesome, and which contain no dyes, chemicals, preservatives, or ingredients which render such meat or meat food products unsound, unhealthful, unwholesome, or unfit for human food; and said inspectors shall label, mark, stamp, or tag as "Inspected and condemned" all such products found unsound, unhealthful, and unwholesome, or which contain dyes, chemicals, preservatives, or ingredients which render such meat or meat food products unsound, unhealthful, unwholesome, or unfit for human food, and all such condemned meat food products shall be destroyed for food purposes, as hereinbefore provided, and the Secretary of Agriculture may remove inspectors from any establishment which fails to so destroy such condemned meat food products: *Provided*, That, subject to the rules and regulations of the Secretary of Agriculture, the provisions hereof in regard to preservatives shall not apply to meat food products for export to any foreign country and which are prepared or packed according to the specifications or directions of the foreign purchaser, when no substance is used in the preparation or packing thereof in conflict with the laws of the foreign country to which said article is to be exported; but if said article shall be in fact sold or offered for sale for domestic use or consumption then this proviso shall not exempt said article from the operation of all the provisions of this act.

That when any meat or meat food product prepared for interstate or foreign commerce which has been inspected as hereinbefore provided and marked "Inspected and passed" shall be placed or packed in any can, pot, tin, canvas, or other receptacle or covering in any establishment where inspection under the provisions of this act is maintained, the person, firm, or corporation preparing said product shall cause a label to be attached to said can, pot, tin, canvas, or other receptacle or covering, under the supervision of an inspector, which label shall state that the contents thereof have been "inspected and passed" under the provisions of this act; and no inspection and examination of meat or meat food products deposited or inclosed in cans, tins, pots, canvas, or other receptacle or covering in any establishment where inspection under the provisions of this act is maintained shall be deemed to be complete until such meat or meat food products have been sealed or inclosed in said can, tin, pot, canvas, or other receptacle or covering under the supervision of an inspector, and no such meat or meat food products shall be sold or offered for sale by any person, firm, or corporation in interstate or foreign commerce under any false or deceptive name; but established trade name or names which are usual to such products and which are not false and deceptive and which shall be approved by the Secretary of Agriculture are permitted.

The Secretary of Agriculture shall cause to be made, by experts in sanitation or by other competent inspectors, such inspection of all slaughtering, meat canning, salting, packing, rendering, or similar establishments in which cattle, sheep, swine, and goats are slaughtered and the meat and meat food products thereof are prepared for interstate or foreign commerce as may be necessary to inform himself concerning the sanitary conditions of the same, and to prescribe the rules and regulations of sanitation under which such establishments shall be maintained; and where the sanitary conditions of any such establishment are such that the meat or meat food products are rendered unclean, unsound, unhealthful, unwholesome, or otherwise unfit for human food, he shall refuse to allow said meat or meat food products to be labeled, marked, stamped, or tagged as "inspected and passed."

That the Secretary of Agriculture shall cause an examination and inspection of all cattle, sheep, swine, and goats, and the food products thereof, slaughtered and prepared in the establishments hereinbefore described for the purposes of interstate or foreign commerce to be made during the nighttime as well as during the daytime when the slaughtering of said cattle, sheep, swine, and goats, or the preparation of said food products is conducted during the nighttime.

That on and after October 1, 1906, no person, firm, or corporation shall transport or offer for transportation, and no carrier of interstate or foreign commerce shall transport or receive for transportation from one State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, or to any place under the jurisdiction of the United States, or to any foreign country, any carcasses or parts thereof, meat, or meat food products thereof which have not been inspected, examined, and marked as "inspected and passed," in accordance with the terms of this act and with the rules and regulations prescribed by the Secretary of Agriculture: *Provided*, That all meat and meat food products on hand on October 1, 1906, at establishments where inspection has not been maintained, or which have been inspected under existing law, shall be examined and labeled under such rules and regulations as the Secretary of Agriculture shall prescribe, and then shall be allowed to be sold in interstate or foreign commerce.

That no person, firm, or corporation, or officer, agent, or employee thereof, shall forge, counterfeit, simulate, or falsely represent, or shall without proper authority use, fail to use, or detach, or shall knowingly or wrongfully alter, deface, or destroy, or fail to deface or destroy, any of the marks, stamps, tags, labels, or other identification devices provided for in this act, or in and as directed by the rules and regulations prescribed hereunder by the Secretary of Agriculture, on any carcasses, parts of carcasses, or the food product, or containers thereof, subject to the provisions of this act, or any certificate in relation thereto, authorized or required by this act or by the said rules and regulations of the Secretary of Agriculture.

That the Secretary of Agriculture shall cause to be made a careful inspection of all cattle, sheep, swine, and goats intended and offered for export to foreign countries at such times and places, and in such manner as he may deem proper, to ascertain whether such cattle, sheep, swine, and goats are free from disease.

And for this purpose he may appoint inspectors who shall be authorized to give an official certificate clearly stating the condition in which such cattle, sheep, swine, and goats are found.

And no clearance shall be given to any vessel having on board cattle, sheep, swine, or goats for export to a foreign country until the owner or shipper of such cattle, sheep, swine, or goats has a certificate from the inspector herein authorized to be appointed, stating that the said cattle, sheep, swine, or goats are sound and healthy, or unless the Secretary of Agriculture shall have waived the requirement of such certificate for export to the particular country to which such cattle, sheep, swine, or goats are to be exported.

That the Secretary of Agriculture shall also cause to be made a careful inspection of the carcasses and parts thereof of all cattle, sheep, swine, and goats, the meat of which, fresh, salted, canned, corned, packed, cured, or otherwise prepared, is intended and offered for export to any foreign country, at such times and places and in such manner as he may deem proper.

And for this purpose he may appoint inspectors who shall be authorized to give an official certificate stating the condition in which said cattle, sheep, swine, or goats, and the meat thereof, are found.

And no clearance shall be given to any vessel having on board any fresh,



salted, canned, corned, or packed beef, mutton, pork, or goat meat, being the meat of animals killed after the passage of this act, or except as hereinbefore provided for export to and sale in a foreign country from any port in the United States, until the owner or shipper thereof shall obtain from an inspector appointed under the provisions of this act a certificate that the said cattle, sheep, swine, and goats were sound and healthy at the time of inspection, and that their meat is sound and wholesome, unless the Secretary of Agriculture shall have waived the requirements of such certificate for the country to which said cattle, sheep, swine, and goats or meats are to be exported.

That the inspectors provided for herein shall be authorized to give official certificates of the sound and wholesome condition of the cattle, sheep, swine, and goats, their carcasses and products as herein described, and one copy of every certificate granted under the provisions of this act shall be filed in the Department of Agriculture, another copy shall be delivered to the owner or shipper, and when the cattle, sheep, swine, and goats, or their carcasses and products, are sent abroad, a third copy shall be delivered to the chief officer of the vessel on which the shipment shall be made.

That no person, firm, or corporation engaged in the interstate commerce of meat or meat food products shall transport or offer for transportation, sell or offer to sell any such meat or meat food products in any State or Territory or in the District of Columbia or any place under the jurisdiction of the United States, other than in the State or Territory or in the District of Columbia or any place under the jurisdiction of the United States in which the slaughtering, packing, canning, rendering, or other similar establishment owned, leased, operated by said firm, person, or corporation is located unless and until said person, firm, or corporation shall have complied with all of the provisions of this act.

That any person, firm, or corporation, or any officer or agent of any such person, firm, or corporation, who shall violate any of the provisions of this act shall be deemed guilty of a misdemeanor and shall be punished on conviction thereof by a fine of not exceeding \$10,000 or imprisonment for a period not more than two years, or by both such fine and imprisonment, in the discretion of the court.

That the Secretary of Agriculture shall appoint from time to time inspectors to make examination and inspection of all cattle, sheep, swine, and goats, the inspection of which is hereby provided for, and of all carcasses and parts thereof, and of all meats and meat food products thereof, and of the sanitary conditions of all establishments in which such meat and meat food products hereinbefore described are prepared; and said inspectors shall refuse to stamp, mark, tag, or label any carcass or any part thereof, or meat food product therefrom, prepared in any establishment hereinbefore mentioned, until the same shall have actually been inspected and found to be sound, healthful, wholesome, and fit for human food, and to contain no dyes, chemicals, preservatives, or ingredients which render such meat food product unsound, unhealthful, unwholesome, or unfit for human food, and to have been prepared under proper sanitary conditions, hereinbefore provided for; and shall perform such other duties as are provided by this act and by the rules and regulations to be prescribed by said Secretary of Agriculture; and said Secretary of Agriculture shall, from time to time, make such rules and regulations as are necessary for the efficient execution of the provisions of this act, and all inspections and examinations made under this act shall be such and made in such manner as described in the rules and regulations prescribed by said Secretary of Agriculture not inconsistent with the provisions of this act.

That any person, firm, or corporation, or any agent or employee of any person, firm, or corporation who shall give, pay, or offer, directly or indirectly, to any inspector, deputy inspector, chief inspector, or any other officer or employee of the United States authorized to perform any of the duties prescribed by this act or by the rules and regulations of the Secretary of Agriculture any money or other thing of value, with intent to influence said inspector, deputy inspector, chief inspector, or other officer or employee of the United States in the discharge of any duty herein provided for, shall be deemed guilty of a felony and, upon conviction thereof, shall be punished by a fine not less than \$5,000 nor more than \$10,000 and by imprisonment not less than one year nor more than three years; and any inspector, deputy inspector, chief inspector, or other officer or employee of the United States authorized to perform any of the duties prescribed by this act who shall accept any money,

gift, or other thing of value from any person, firm, or corporation, or officers, agents, or employees thereof, given with intent to influence his official action, or who shall receive or accept from any person, firm, or corporation engaged in interstate or foreign commerce any gift, money, or other thing of value given with any purpose or intent whatsoever, shall be deemed guilty of a felony and shall, upon conviction thereof, be summarily discharged from office and shall be punished by a fine not less than \$1,000 nor more than \$10,000 and by imprisonment not less than one year nor more than three years.

That the provisions of this act requiring inspection to be made by the Secretary of Agriculture shall not apply to animals slaughtered by any farmer on the farm and sold and transported as interstate or foreign commerce, nor to retail butchers and retail dealers in meat and meat food products, supplying their customers: *Provided*, That if any person shall sell or offer for sale or transportation for interstate or foreign commerce any meat or meat food products which are diseased, unsound, unhealthful, unwholesome, or otherwise unfit for human food, knowing that such meat food products are intended for human consumption, he shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding \$1,000 or by imprisonment for a period of not exceeding one year, or by both such fine and imprisonment: *Provided also*, That the Secretary of Agriculture is authorized to maintain the inspection in this act provided for at any slaughtering, meat canning, salting, packing, rendering, or similar establishment notwithstanding this exception, and that the persons operating the same may be retail butchers and retail dealers or farmers; and where the Secretary of Agriculture shall establish such inspection then the provisions of this act shall apply notwithstanding this exception.

That there is permanently appropriated, out of any money in the Treasury not otherwise appropriated, the sum of \$3,000,000, for the expenses of the inspection of cattle, sheep, swine, and goats and the meat and meat food products thereof which enter into interstate or foreign commerce and for all expenses necessary to carry into effect the provisions of this act relating to meat inspection, including rent and the employment of labor in Washington and elsewhere, for each year. And the Secretary of Agriculture shall, in his annual estimates made to Congress, submit a statement in detail showing the number of persons employed in such inspections and the salary or per diem paid to each, together with the contingent expenses of such inspectors and where they have been and are employed.

## REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
*Washington, D. C., September 20, 1906.*

SIR: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1906.

Respectfully,

B. T. GALLOWAY,  
*Chief of Bureau.*

HON. JAMES WILSON, *Secretary.*

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### GENERAL WORK OF THE YEAR.

The appropriations for the Bureau of Plant Industry for the fiscal year ended June 30, 1906, amounted to \$892,436. Of this sum \$105,556 was expended from the special appropriation made for the purpose of meeting the ravages of the cotton boll weevil. Approximately 29 per cent of the total appropriation was expended for administrative work and 71 per cent for strictly scientific work. In addition to the regular appropriations, the sum of \$3,437.33 was realized from the sale of fruits used in the fruit marketing and storage experiments, which, as provided by law, was applied to defraying the expenses of those investigations.

### BUSINESS OPERATIONS.

During the year 4,100 requisitions were issued; 10,000 accounts were received, audited, and paid; 529 requests for contracts were made, and 602 letters of authorization were drawn. The system of accounting outlined in my last report has proved very effective, and has undergone, as experience and practice have warranted, several modifications and improvements, among which may be mentioned the following:

(1) *Retained copies of vouchers discontinued.*—It was found that the making of copies of all vouchers involved extra work, required considerable space for filing, and that the vouchers were rarely referred to. The practice was, therefore, discontinued, and in lieu thereof a brief abstract slip was devised, upon which is noted by stamp or otherwise the essential facts with regard to each voucher, so that each slip furnishes a brief but complete history of each account to which it pertains. These abstract slips are entered, checked, and filed in the same manner as the copies of vouchers, and their use has resulted in economy of time, labor, and filing space.



(2) *Typewriting of requisitions.*—Formerly three copies of each requisition were made separately by hand, namely, the purchasing requisition, the auditing copy, and the requisition stub. Early in the past fiscal year this practice was discontinued, and the three copies are now made on the typewriter at a single operation, thereby effecting a saving of two-thirds of the time and labor involved in their preparation, as well as greatly reducing the chance of error.

(3) *Daily balances.*—The frequent calls from administrative officers and members of the scientific staff of the Bureau for information as to the condition of their allotments led to the adoption of a loose-leaf daily balance book. The sheets show the titles and numbers of the individual accounts and are arranged numerically by account numbers, so that any particular account may be found at once and with certainty by turning to the page number, which is also the account number. Each balance sheet has a column for paid items, one for liabilities, and one showing the balance of the allotment. A similar daily balance book is kept for letters of authorization. As these books also furnish a complete and absolute check on the account cards, the system of auditor's memorandum cards mentioned in the last report was discontinued as being no longer necessary. By means of this new system of daily balances the balance of any particular allotment of funds or letter of authorization can be given at a moment's notice, usually by telephone, and it was found especially useful toward the close of the fiscal year when the funds were running low. Such a system makes it practically impossible to create a deficit.

The last session of Congress, upon the recommendation of the Secretary of Agriculture, adopted a codification of the appropriations for the scientific investigations of the Bureau of Plant Industry which greatly simplifies the heretofore complex form of the appropriations of the Bureau. When the Bureau was organized, in 1901, the appropriations for the various divisions which comprise it were brought together as separate items under the general heading of "General expenses, Bureau of Plant Industry," the wording of the original clauses of the old divisions being maintained from year to year, with various additions as the scope of the work was enlarged. The result of this was a great accumulation of verbiage and a cumbersome system of individual and distinct funds. These clauses have now been combined into a condensed, abstract form providing for all work conducted under the appropriation for general expenses, thus bringing into one account all business operations which formerly affected eight distinct appropriations.

The Bureau has received and answered during the past fiscal year about 215,000 letters, covering a wide range of subjects. This number does not include routine correspondence, such as requests for publications, seeds, etc., being made to cover only such letters as have called for specific and direct replies. The number of letters received during the year making inquiries requiring specially prepared answers regarding the work on nitrogen-fixing bacteria was considerably smaller than in the preceding year. While a great number of such letters are still received, it is now possible to answer most inquiries of this nature by the mailing of bulletins on the subject.

## PUBLICATIONS.

The publication work of the Bureau has continued in charge of Mr. J. E. Rockwell, editor, as heretofore.

The total number of new publications issued during the year is 62, aggregating 1,672 printed pages and illustrated with 109 full-page plates and 210 text figures.

In the Bureau series there were issued during the year 25 new bulletins or parts of bulletins, aggregating, in first editions, 84,500 copies. These publications covered a wide range of subjects, as will be shown by the following list:

- No. 77. The Avocado, a Salad Fruit from the Tropics.
  - 78. Improving the Quality of Wheat.
  - 79. The Variability of Wheat Varieties in Resistance to Toxic Salts.
  - 80. Agricultural Explorations in Algeria.
  - 81. Evolution of Cellular Structures.
  - 82. Grass Lands of the South Alaska Coast.
  - 83. The Vitality of Buried Seeds.
  - 84. The Seeds of the Bluegrasses.
  - 85. The Principles of Mushroom Growing and Mushroom Spawn Making.
  - 86. Agriculture without Irrigation in the Sahara Desert.
  - 87. Disease Resistance of Potatoes.
  - 88. Weevil-Resisting Adaptations of the Cotton Plant.
  - 89. Wild Medicinal Plants of the United States.
  - 90. Part I. The Storage and Germination of Wild Rice Seed. Part II. The Crown-Gall and Hairy-Root Diseases of the Apple Tree. Part III. Peppermint. Part IV. The Poisonous Action of Johnson Grass.
  - 90. Miscellaneous Papers. [Parts I to IV reprinted.]
  - 91. Varieties of Tobacco Seed Distributed in 1905-6, with Cultural Directions.
  - 93. The Control of Apple Bitter-Rot.
  - 100. Part I. Cranberry Spraying Experiments in 1905. Part II. The Wrapping of Apple Grafts and Its Relation to the Crown-Gall Disease. Part III. Garlicky Wheat. Part IV. Methods of Testing the Burning Quality of Cigar Tobacco.
- Additions and Corrections Affecting Bulletin No. 56, Entitled "Nomenclature of the Apple."

To the Department series of Farmers' Bulletins, 14 new numbers dealing with various subjects of a popular nature were contributed by the Bureau of Plant Industry during the fiscal year just passed, as follows:

- No. 229. The Production of Good Seed Corn.
- 231. Spraying for Cucumber and Melon Diseases.
- 232. Okra: Its Culture and Uses.
- 238. Citrus Fruit Growing in the Gulf States.
- 240. Inoculation of Legumes.
- 242. An Example of Model Farming.
- 243. Fungicides, and Their Use in Preventing Diseases of Fruits.
- 245. Renovation of Worn-Out Soils.
- 246. Saccharine Sorghums for Forage.
- 248. The Lawn.
- 250. The Prevention of Stinking Smut of Wheat and Loose Smut of Oats.
- 253. The Germination of Seed Corn.
- 254. Cucumbers.
- 255. The Vegetable Garden.

In addition to those mentioned in the preceding list, Farmers' Bulletin No. 247, "The Control of the Codling Moth and Apple Scab," was prepared and issued during the year by this Bureau and the Bureau of Entomology jointly.

Eleven articles were contributed by the Bureau of Plant Industry to the Yearbook for 1905, covering the subjects of fruits, drug plants, diversified farming in the cotton belt (a series of four papers), plant breeding, etc. In addition to the publication of these papers in the Yearbook in an edition of 500,000 copies, each of these articles was reprinted in separate form for special distribution. The customary articles on fruit growing and plant diseases were also furnished by the Bureau for the appendix of the Yearbook, as was also an article on progress in farm management. A bulletin was contributed by the Bureau to the series of the Office of Experiment Stations and another to that of the Bureau of Animal Industry. Four circulars contributed to the series issued by the Office of the Secretary were printed in editions aggregating 93,000 copies.

An important feature of the publication work of the Bureau is the reprinting of its publications. During the past year reprinted editions, aggregating 10,700 copies of various Bureau bulletins, were issued to meet the demand for these publications. Five bulletins of offices formerly separate divisions but now a part of the Bureau were reprinted during the year. Of the forty-six Farmers' Bulletins contributed by this Bureau since its organization, all but one (which has been superseded) have been reissued from time to time as required to meet the demands of applicants for publications in this series, a demand which necessitates the issue of more than six million copies annually. Six articles printed in Yearbooks prior to 1905 were reissued, while new editions of several circulars of information on various agricultural crops were also called for.

The total number of original and reprinted publications of the Bureau, exclusive of circulars, issued during the year exceeded 2,200,000 copies.

#### ORGANIZATION AND POLICY.

As stated in last year's report, the nature of the Bureau's work requires that changes in organization be made from time to time in the interest of a better administration of the work. The organization of the Bureau has undergone several such changes during the past year which were made necessary by the growth and development of certain lines of work. The branch of the Bureau formerly known as Vegetable Pathological and Physiological Investigations and under the general charge of Mr. Albert F. Woods, Pathologist and Physiologist, has been subdivided into eleven coordinate offices, and Mr. Woods has been directly charged with the title and duties of Assistant Chief of Bureau. The various lines of work of the Bureau have been grouped under seven general headings, as follows: Pathological Investigations; Physiological Investigations; Taxonomic Investigations; Agronomic Investigations; Horticultural Investigations; Seed and Plant Introduction Investigations; and Special Laboratories, Gardens, and Farms. This grouping is merely for the purpose of classifying the work, no one officer being placed in charge of an entire group. Under the plan of reorganization all heads of coordinate offices are made directly responsible for the line or lines of work under their charge, and are directly accountable to the chief



and the assistant chief of the Bureau. The present organization of the Bureau is as follows:

Pathologist and Physiologist, and Chief of Bureau, B. T. Galloway; Pathologist and Physiologist, and Assistant Chief, Albert F. Woods; Chief Clerk, James E. Jones; Editor, J. E. Rockwell.

Pathological Investigations: Laboratory of Plant Pathology, Erwin F. Smith. Pathologist in Charge; Diseases of Fruits, Merton B. Waite, Pathologist in Charge.

Physiological Investigations: Plant Breeding, Herbert J. Webber, Physiologist in Charge; Plant Life History, Walter T. Swingle, Physiologist in Charge; Soil Bacteriology and Water Purification, Karl F. Kellerman, Physiologist in Charge; Bionomic Investigations of Tropical and Subtropical Plants, O. F. Cook, Bionomist in Charge; Drug and Poisonous Plant Investigations, and Tea Culture Investigations, Rodney H. True, Physiologist in Charge; Physical Laboratory, Lyman J. Briggs, Physicist in Charge.

Taxonomic Investigations: Systematic Botany and Economic Collections, Frederick V. Coville, Botanist in Charge; Fiber Plant Investigations, Lyster H. Dewey, Botanist in Charge.

Agronomic Investigations: Farm Management, W. J. Spillman, Agriculturist in Charge; Grain Investigations, Mark A. Carleton, Cerealist in Charge; Arlington Experimental Farm, L. C. Corbett, Horticulturist in Charge; Sugar Beet Investigations, Charles O. Townsend, Pathologist in Charge; Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge; Dry Land Agriculture, E. C. Chilcott, Agriculturist in Charge.

Horticultural Investigations: Pomological Collections, G. B. Brackett, Pomologist in Charge; Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge; Experimental Gardens and Grounds, E. M. Byrnes, Superintendent.

Seed and Plant Introduction Investigations: Seed and Plant Introduction and Distribution, David Fairchild, Agricultural Explorer in Charge; Seed Laboratory, Edgar Brown, Botanist in Charge.

Special Laboratories, Gardens, and Farms: Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge; Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge; Plant Introduction Garden, Chico, Cal., P. H. Dorsett, Pathologist in Charge; Cotton Culture Farms, S. A. Knapp, Special Agent in Charge, Lake Charles, La.

The work of the former Pacific Coast Laboratory, conducted up to July 1, 1906, at Santa Ana, Cal., was on that date abandoned.

The organization outlined has been adhered to in the preparation of this report, the various lines of work being discussed in the order of their appearance in the preceding list. It is believed that under the organization now effected the various branches of the Bureau's work can be prosecuted to the best advantage, and that uniformity in the work and policy of the Bureau as a whole will be secured.

From the 1st of September, 1905, to the 1st of September, 1906, the following changes have been made in the personnel of the Bureau: Resignations, 38; deaths, 5; dismissal, 1; transfers from the Bureau, 17, and furloughs and terminations of appointments, 159; making a total of 220 employees dropped from the rolls during that period. During the same period there have been made 352 appointments, increasing the total force of the Bureau by 132. On September 1, 1906, the numerical strength of the Bureau was as follows: In Washington, 369; outside of Washington, 271; total 640. The total number of employees in the Bureau on the same date a year ago was 508.

A plan has been put into effect by which it is believed the efficiency of the clerical staff of the Bureau will be improved and the question of promotions and all other changes in grade placed upon an entirely

equitable basis. Owing to the location in many different buildings of the various offices of the Bureau, it has heretofore been the policy throughout the Bureau that where a vacancy would occur in a clerical grade in any particular office it would be filled by the promotion of the most deserving employee or employees in that office, without reference to the fitness for advancement of clerks in other parts of the Bureau. Under the present plan an efficiency board is created which will consider semiannually the qualifications of all clerical employees of the Bureau, as set forth by the respective executive officers to whom they are assigned, establishing an efficiency register for each grade and notifying each employee thereon of his relative standing. It is believed that this system will be very practicable, as no employee will be overlooked, his merits will be carefully considered at stated intervals, and his relative standing and chances for promotion will depend entirely upon his own individual efforts. Certain qualities are given relatively great weight in determining efficiency and standing; improvement along these lines will secure a higher rating, and the one having the highest average among those of his grade will invariably be promoted to any vacancy occurring in the next higher grade so long as he maintains his position at the head of the list and does nothing to forfeit his right of precedence. This rule will be strictly adhered to in all cases and no exceptions will be made for any cause. Employees who fall below a fair standard of efficiency will just as surely be recommended for reduction or dismissal, as circumstances warrant, in order to make room for more efficient employees.

#### COOPERATION WITH THE STATE EXPERIMENT STATIONS.

The plan outlined in last year's report of close cooperation wherever practicable with the State experiment stations has been continued. The Bureau is now actively cooperating in various lines of work with about forty stations, including those of almost every State and Territory. A perusal of this report will give a proper idea of the many lines of cooperative effort in progress between the State experiment stations and the Bureau of Plant Industry.

#### SCHOOL GARDEN WORK.

Public interest in the school garden movement has not waned during the year. In fact, the distribution of special collections of flower and vegetable seeds for individual school gardens, as well as of a collection of seeds for decorating school grounds, has been more general than was the case last year. Every State and Territory, except Nevada and Wyoming, are represented upon the mailing list of the Bureau in its school garden work. The distribution of seeds for this purpose during the preceding year amounted to 155,870 packets of flower seeds, 150,520 packets of vegetable seeds, and 71,150 packets of decorative flower seeds, making a total of 377,540 packets. It is safe to say that about 75,500 school gardens have been provided for in the last year's distribution, or about twice as many as were reached in the distribution of the preceding year. The largest distribution of the past year was made to the State of Illinois, the second largest to New

York, the third largest to Pennsylvania, with Massachusetts fourth upon the list. During the preceding year New York received the largest distribution, Ohio the second largest, and New Jersey third largest. It is evident that the school garden movement is westward bound.

It can safely be said that more than a thousand teachers of schools in various parts of the country are interested in this work. The gratifying reports which are received from this distribution make it evident that it is meeting with good results and is filling a very useful place in the school work of our country. It is certain that hundreds of children who knew little or nothing of the manner of growth and methods of cultivation of the various garden crops and flowers have been given the rudiments of agriculture through the distribution of seeds to the schools, and that many minds which were never before interested in agriculture have a live interest in the subject at the present time.

The work in cooperation with the normal schools of Washington, D. C., has been continued on a plot of about 3 acres in the northeast corner of the Department grounds. This is the most extensive work of this kind yet undertaken on the grounds, and has been very successful. The work, as in preceding years, has been in charge of Miss Susan B. Sipe, of Normal School No. 1, and has been continued throughout the summer as a vacation garden for the school children of the city. Great interest has been manifested in this work.

#### GRAIN INSPECTION LEGISLATION.

During the past three or four years the matter of grain grading and grain inspection has been brought to the attention of the Department of Agriculture a number of times. Each year one or more bills have been introduced in Congress looking to the improvement of conditions affecting grain entering into interstate and foreign commerce. During the last session of Congress there was an energetic movement toward securing legislation on this subject. The Senate Committee on Agriculture had a number of hearings, at which the question was discussed from various standpoints. On the floor of the Senate speeches were made which are valuable contributions to our knowledge of the subject. Finally, in the last appropriation bill for the Department of Agriculture, the following clause was inserted in the appropriation for the Bureau of Plant Industry:

To enable the Secretary of Agriculture to establish, at such points of export as he may deem expedient, laboratories for the purpose of examining and reporting upon the nature, quality, and condition of any sample, parcel, or consignment of seed or grain. \* \* \* And the Secretary of Agriculture is authorized to report upon such samples, parcels, or consignments from time to time, and the reports so made shall serve as a basis for the fixing of definite grades and for the issuance of certificates of inspection when requested by the consignor or consignee of any grain entering into interstate or foreign commerce.

This law went into effect on July 1, 1906, and after giving all the points in question careful consideration, and the holding of conferences with a number of chambers of commerce, it has been decided, with the approval of the Secretary, to establish two laboratories in accordance with the provisions of the appropriation bill, one



at Baltimore, Md., and the other at New Orleans, La. These are now being equipped for carrying out the work. Apparatus has already been perfected for the quick determination of the moisture content of grain, and it will be the object of the laboratories to take up at once the analysis of samples with a view to securing definite information on the condition of grain intended for interstate or foreign commerce.

An agent will also be stationed in foreign countries who will examine cargoes of grain on their arrival at European and other foreign ports from the United States. This feature of the work has received considerable attention during the past year. An agent was sent abroad for the purpose of inspecting and reporting upon cargoes of American export grain arriving at European ports. Particular attention was paid to corn shipments, 35 cargoes of this grain, containing approximately 124,826 tons from seven of the principal Atlantic and Gulf ports, having been inspected by the agent.

#### IMPROVEMENT OF ROADS IN DEPARTMENT GROUNDS.

At the last session of Congress the sum of \$3,500 was included in the appropriation for the Bureau of Plant Industry, to be used in improving and macadamizing the gravel roads on the Department grounds, under the supervision of the Director of the Office of Public Roads. This work has been inaugurated and is progressing very satisfactorily.

#### PATHOLOGICAL INVESTIGATIONS.

Under the reorganization of the scientific work of the Bureau, all lines of work of an entirely pathological character conducted from headquarters in the city of Washington have been grouped under the general heading of Pathological Investigations. For purposes of administration, the investigations are subdivided into two working branches, (1) the Laboratory of Plant Pathology, and (2) Diseases of Fruits, with Dr. Erwin F. Smith and Mr. M. B. Waite, respectively, as pathologists in charge. Summarized statements of the progress of these investigations during the past fiscal year follow.

#### LABORATORY OF PLANT PATHOLOGY.

The general work of the Laboratory of Plant Pathology has continued along the same lines as heretofore. Specimens of diseased plants and requests for information as to causes and remedies have been received from numerous sources, including various foreign countries. The identification of these diseases and suggestions as to remedies, where known, have consumed considerable time during the year. In addition to this, the regular routine work of the laboratory, which includes the study of the life history of various plant parasites, has been vigorously prosecuted. Numerous diseases of plants have been studied, many of these being brought to attention through correspondence. Researches have also been conducted on the effect of special plant foods, on resistance to disease, and on the effect of freezing on fungi and bacteria. Work will be continued in all of these lines.

**RICE DISEASES.**—The results of Dr. Haven Metcalf's researches on the blast and other diseases of rice, made while botanist of the South Carolina Experiment Station and collaborator of this Bureau, have been published as Bulletin No. 121 of that station. Investigations as to the exact nature of the blast and the means of controlling it are being continued by Doctor Metcalf, as a pathologist of this Bureau, while Director J. N. Harper, of the South Carolina Experiment Station, a collaborator of the Bureau, is conducting field experiments along the same line.

**COTTON DISEASES.**—Mr. W. A. Orton, pathologist, has continued his investigations of cotton diseases in the Southeastern States. A test of a number of varieties of Sea Island cotton for wilt resistance has been continued on wilt-infected land at Blackshear, Ga., with the result that various strains of seed of the Rivers variety have continued very resistant to the disease. The variety known as Centerville has proved the most promising for Georgia and Florida, both because of its wilt resistance and its high productiveness of a strong, desirable lint. A number of individual selections from this variety for increased vigor and productiveness were made and grown last year, for the first time, with very promising results. The 25-acre rotation experiment was continued at Blackshear, Ga., during the past season, including fertilizer tests, trials of some of the leading varieties of cotton grown in Georgia and Florida, and trials also of legumes and other crops in rotation with cotton, the comparative value of different systems of rotation for cotton being very clearly shown. A marked difference was noticed in the comparative resistance of the different varieties to the black-arm disease, which was very serious on Egyptian varieties, but Centerville Sea Island cotton growing in adjoining rows was but slightly affected. The work on boll shedding was continued at Auburn, Ala., with satisfactory progress, but further study is necessary before any definite and conclusive results will be at hand.

Twelve acres of Upland cotton were grown from selected seed at Tallassee, Ala., and one acre at Notasulga, Ala., for the purpose of developing a more desirable wilt-resistant strain for distribution in the near future. Very promising results were obtained in the selection of strains more nearly approaching the type desired. A wilt-resistant strain known as the Jackson has been distributed to a considerable extent during the past year.

The work on cotton diseases in the Southwest, conducted by Dr. C. L. Shear, pathologist, has been confined during the past year chiefly to a continuation of the investigation of the Texas root-rot. It has been determined by a study of the type specimens of *Ozonium auricomum* that the organism causing the disease does not belong to this species. Besides the laboratory investigations of the root-rot organisms, the three lines of field work already started have been continued. Attempts to secure an immune variety of cotton have so far been unsuccessful. The progeny of plants selected under the most favorable conditions did not show any signs of immunity to the disease. The application of various chemicals to the soil has been tried thoroughly, but without beneficial results of any practical importance. Methods of cultivation, especially deep fall plowing with rotation of crops, give promise of practical success. A series of

experiments along this line is now under way, and very promising results have already been obtained. It is expected that the greatest effort in the future will be along these lines, in order to test thoroughly and perfect the methods and to demonstrate their practicability.

**WILT-RESISTANT MELONS AND COWPEAS.**—Mr. W. A. 'Orton has continued the work of breeding wilt-resistant watermelons and cowpeas. Ten acres of watermelon selections were grown last year at Monetta, S. C., and satisfactory progress was made in the effort to fix the quality of wilt resistance in a desirable market melon. The cooperative work with the North Carolina Experiment Station along the same line was continued at Auburn, N. C., on 20 half-acre plots, a number of new hybrids being grown for the first time, from which several promising selections were made. Both of these lines of work will require further study for their completion. The experiments on cowpeas, looking to the development of a wilt-resistant type better adapted for forage purposes, were continued on an acre of land at Monetta, S. C., and a number of new hybrids between the Iron variety and some of the larger forage cowpeas were grown for the first time. Nearly all of these proved wilt resistant and will be grown again this year.

**DISEASE RESISTANCE OF POTATOES.**—The first of a series of three cooperative trials to test the reputed disease resistance of a large collection of European varieties of potatoes obtained by Prof. L. R. Jones, of the Vermont Experiment Station, has been carried on with the Vermont, Colorado, Oregon, and Florida experiment stations and at the Arlington Experimental Farm, and promising results have been secured in the disease resistance of certain varieties tested. Efforts are also being made at the Vermont station to secure strains resistant to *Phytophthora* by crossing some of the most resistant native varieties with wild potatoes brought from Mexico by Mr. C. G. Pringle.

**MISCELLANEOUS DISEASES OF PLANTS.**—Progress has been made in the study of pecan diseases, and experiments have been carried on for the control of the pecan scab on fruits and leaves by means of spraying, with satisfactory results. The demonstration experiment conducted at Charleston, S. C., for the last two seasons, for the purpose of controlling by spraying the downy mildew and other diseases of cucumbers and melons, has been brought to completion, and a Farmers' Bulletin embodying the results of the experiment has been issued. The customary article on the prevalence of plant diseases was prepared from the data secured by means of the plant disease survey and published in the Yearbook for 1905. The work in this line has been largely increased during the past year by the appointment of collaborators at ten experiment stations to assist in the collection of accurate data on the prevalence and spread of plant diseases.

Diseases of clover, lettuce, spinach, alfalfa, and cultivated daisies have been under investigation during the year by Dr. C. O. Townsend, Pathologist in Charge of Sugar Beet Investigations. The fungus producing the clover disease has been isolated, and its life history is being studied, together with the means of its attacking the clover, its propagation and spread, and the best means for its control. The organism producing the lettuce disease has been found and is



under investigation. Certain varieties of lettuce seem to be resistant to this disease, and experiments are under way for the determination of the resistant varieties. The spinach and alfalfa organisms have not yet been determined with certainty, but are still being investigated. The organism that produces the daisy disease has been isolated and is being studied for the purpose of determining the condition under which it lives and spreads, with a view to finding some practical means for its suppression and control.

**MYCOLOGICAL AND PATHOLOGICAL COLLECTIONS.**—The work connected with the mycological and pathological collections has during the past year been more closely connected with the Laboratory of Plant Pathology. A large quantity of material received from correspondents is examined and any fungi associated with the troubles identified. Much work of this kind is also done for the State experiment stations and for those of Hawaii and Porto Rico. Material is also sent in from the plant disease survey both for identification and for preparation for reference. The inspection of the Department greenhouses and material intended for shipment to various points in the United States and foreign countries is carefully carried out, and this material is quarantined if affected by any dangerous disease, or given a clean bill of health, as the case may be. The danger of introducing fungous diseases in our seed and plant introduction work has shown that it is necessary that the closest attention be given to this inspection work. The condition of the collections has been improved during the year. All of the material is in shape for ready consultation, and is extensively used by Department and outside workers.

#### INVESTIGATIONS OF DISEASES OF FRUITS.

The work on fruit diseases has been partially reorganized during the year, being placed under the immediate direction of Mr. M. B. Waite, pathologist, with Dr. C. L. Shear, pathologist, in charge of diseases of small fruits and grapes, and Mr. W. M. Scott, pathologist, in charge of spraying demonstrations for orchard diseases. Without attempting to mention all the minor subjects which have been under investigation, the following may be cited as receiving principal attention.

**PEAR-BLIGHT.**—Most of the work on pear-blight during the past year has been carried on in California on account of the urgent situation in that State. The California pear orchards, conservatively valued at 15 million dollars, have already been about one-third destroyed. The problem of saving the remaining orchards is a difficult one, and is receiving a large part of the attention of this office. Instead of conducting test orchards, as was done last year in cooperation with the California Experiment Station, efforts have been made to secure a general eradication of the disease over wide areas. Prof. Ralph E. Smith and his staff, of the California Experiment Station, at Berkeley, and also the State horticultural commissioner and the county commissioners have cooperated in this work. Additional men were detailed for this work from the Laboratory of Plant Pathology, so that a force of seven Department men was engaged during February and March, 1906. The same number of men will be put into

the field next winter, and a persistent fight will be made against this disease. In spite of the efforts made during the winter to stamp out the blight, the disease spread with unusual severity during the spring of 1906. The early attacks of the blight were materially reduced in many orchards, but the continued rainy weather, extending well into May, afforded opportunity for the extensive spread of the disease. It is a somewhat doubtful question whether the pear industry of California, as well as the irrigated orchards of Colorado, Idaho, eastern Washington, and Oregon, can be saved from destruction. The uncertainty of the results, however, will make the Department's efforts all the more strenuous.

**LITTLE-PEACH.**—The eradication tests in Michigan for the little-peach disease, carried on in Saugatuck Township over 7 square miles of territory, were continued. The trees were carefully gone over for the third season. Notwithstanding the small number found to be infected the second season and their careful removal, there was an increase in the spread of the malady. This was parallel to an increase in the number of trees affected with little-peach in other parts of Michigan. The number of diseased trees was about 3,000—less than the number found the first year. The orchards in this district are now, however, comparatively free from the disease. Only a relatively few cases have been reported as appearing during the spring of 1906. The work was done in cooperation with the Michigan State inspector of nurseries and orchards, through Mr. Horace Welch, who was appointed deputy State inspector. This definite test may be considered as finished, but a careful watch will be kept over this district to observe the ultimate effect of this work on the diseased orchards. One fact is already certain, namely, that in the heart of the little-peach area, where whole sections have been wiped out by the disease, there remains a peach district with the orchards fairly intact. A similar demonstration to the one in Michigan is now being carried out in New York State in cooperation with the experiment station at Cornell University. Microscopic and inoculation studies of the disease will be continued.

**CALIFORNIA PEACH-BLIGHT.**—The serious disease of California peach orchards, caused by the parasite known as the "gumming fungus," was studied incidentally to other work during the year. The suggestion to several growers at Suisun, Cal., that fall spraying would probably prevent the disease was acted upon by a number of orchardists, and found to be correct. In three cases peach orchards sprayed late in December were almost completely protected from this disease, while adjacent orchards separated only by a line fence had 95 per cent of the crop destroyed. The treatment was with standard Bordeaux mixture. Further investigations are required to determine what dates of treatment will insure success under the varying climatic conditions of different seasons and whether lime-sulphur-salt wash applied in the fall will serve the same purpose. Experiments to determine this will be carried out.

**WINTER INJURIES TO FRUIT TREES.**—The investigations of winter injury to fruit trees, in progress for several years, were given renewed interest by the damage in 1904, and have since been a subject for careful study. The spring frosts of 1906 gave additional opportunities to

study the effects of freezing on fruits in the vicinity of Washington. During the past year the Michigan orchards have again suffered from freezing. Further studies have been made and the different types of frost injury determined. A bulletin is in preparation describing these types and the different methods of treatment that should be applied.

**FUNGICIDES.**—The study of the various points connected with the making and applying of fungicides has continued to occupy attention. A Farmers' Bulletin on "Fungicides and Their Use in Preventing Diseases of Fruits" has been issued, giving in a condensed form the best practical information available on this subject. Additional studies have also been made by Mr. W. M. Scott in connection with the spraying demonstration work and by Dr. C. L. Shear in the work on grape and cranberry diseases. Mr. Scott has thoroughly tested several types of "dust sprays" and has found this method unsatisfactory in the treatment of fungous diseases. The Illinois Experiment Station has had the same experience, so that the value of dusting as a method of applying fungicides is now known to be small.

**SPRAYING DEMONSTRATION WORK.**—Although the treatment for apple scab was worked out by this Department some fifteen years ago, in many sections of the country orchardists are still permitting this serious fungous disease to destroy their crops of apples. The information contained in bulletins is not always utilized by the practical orchardist; he needs an actual demonstration in the vicinity to convince him of the success of the operation. It is found necessary, therefore, in order to secure the greatest practical results, to carry on demonstrations of methods that have already been worked out. During the past season Mr. W. M. Scott has been conducting such work against apple scab in seven counties of Nebraska and against the bitter-rot, apple scab, apple blotch, and leaf-spot diseases in several parts of Missouri and Arkansas. Further work along these lines is looked upon as an important part of our services to the fruit grower, and plans are being made for a considerable extension of this phase of the work.

**BITTER-ROT OF THE APPLE.**—The spraying for bitter-rot of the apple, undertaken by Mr. Scott and mentioned in the last report, gave results in the autumn of 1905 that were particularly gratifying. Four treatments made at just the right time saved 98 per cent of the fruit, while the unsprayed trees had scarcely a single sound apple remaining. These experiments are fully described in Bulletin No. 93 of the Bureau of Plant Industry. They were so entirely satisfactory that the problem of spraying for bitter-rot may be considered as settled, except in so far as this experiment needs corroboration and repetition under different seasonal conditions and in different sections of the country.

**BROWN-ROT OF PEACHES AND STONE FRUITS.**—The brown-rot disease is still under investigation by Mr. W. M. Scott. Last year its serious effects were not limited to the Southern States, but extended into Pennsylvania and New York. Investigations of this disease have given discouraging results up to date, and it remains one of the dis-



eases most difficult to control. The effect of all the spraying preparations so far tested has been to injure the foliage during wet seasons. It is therefore doubtful whether the fruit grower should be advised to risk defoliating his peach trees when there is so little benefit to be derived from the spraying. Notwithstanding the difficult nature of the problem, it will be continued as a subject for investigation. In fact, the efforts to solve it will be all the more persistent.

**CRANBERRY DISEASES.**—The work on cranberry diseases has been continued by Dr. C. L. Shear. Particular attention has been given to spraying methods and apparatus, in order to determine what are most economical and practical under the peculiar conditions encountered in cranberry growing. The spraying experiments already conducted have been remarkably successful in preventing the diseases. A paper on "Cranberry Spraying Experiments in 1905" has been published as Bulletin No. 100, Part I, of the Bureau of Plant Industry. In these experiments the loss from disease, which sometimes reaches between 95 and 100 per cent, was reduced to less than 5 per cent. A bulletin is in preparation giving the complete results of technical investigations of the parasites causing the diseases. Future work will be largely devoted to an improvement of the practical methods of spraying.

**GRAPE DISEASES.**—Dr. C. L. Shear has also investigated grape diseases and methods of treatment. Efforts are being made especially to determine more accurately the life histories of the parasites causing the diseases, and the factors which control their dissemination and development. Spraying experiments are also being conducted for the purpose of simplifying and perfecting the methods of controlling and preventing the diseases. Work is now being carried on in Pennsylvania in cooperation with the State Experiment Station. It is planned to extend the investigations of grape diseases to the other grape-growing sections, where the soil and climatic conditions are different, in order to determine what diseases are most injurious in each section and what local modifications of treatment are necessary to secure the most satisfactory results. A disease the cause of which does not seem to have been discovered heretofore has long caused considerable loss in the vineyards of Pennsylvania and New York. A preliminary investigation has been made of this disease, which attacks the vine and causes the death of a part or the whole of it. In some vineyards a large percentage of the vines are affected. Having discovered the cause, it is believed that a satisfactory method of preventing the trouble has been found. A further study of the disease and a test of the proposed method of preventing it will be carried out. Notwithstanding the great amount of work that has already been done on grape diseases, not only in this country but in Europe, the industry is being abandoned in certain localities on account of the great loss caused by diseases. Besides the necessity for a fuller knowledge of the parasites causing the diseases, it is also desirable that demonstration experiments should be conducted in various localities in order that vineyardists may have an opportunity to see exactly what can be accomplished by proper treatment.

**PHYSIOLOGICAL INVESTIGATIONS.**

The lines of work of a physiological character which were a part of the branch of the Bureau formerly known as Vegetable Pathological and Physiological Investigations have been classed under the general heading of Physiological Investigations, as have also the Bionomic Investigations of Tropical and Subtropical Plants and the Drug and Poisonous Plant Investigations and Tea Culture Investigations. The progress made in all of these lines of work, as reported by the respective officers in charge, is outlined in the following paragraphs.

**PLANT BREEDING INVESTIGATIONS.**

The Plant Breeding Investigations of the Bureau have been carried on, as in previous years, under the immediate direction of Dr. H. J. Webber, physiologist. The work has continued during the past year along essentially the same lines as during the year preceding. Particular attention has been given to the improvement of cotton, corn, tobacco, oats, citrus fruits, pineapples, etc., and a number of new sorts of value have been secured, some of which have been placed with growers and are now being grown on a large scale. The principal lines of investigation during the year have been as follows:

**COTTON BREEDING.**

The work on the improvement of cotton by breeding and selection has proceeded along the same lines as heretofore, special attention being devoted to the production of early varieties of boll weevil infested districts.

**LONG-STAPLE RACES.**—The investigations in the production of races of cotton having longer and better fiber have been continued along two lines: (1) The making and testing of hybrids between various short-staple varieties and the Sea Island or long-staple cottons, and (2) the straight selection of certain short-staple varieties which show a tendency to produce fairly long lint. A number of hybrids have been secured having lint ranging from  $1\frac{1}{4}$  to  $1\frac{5}{8}$  inches in length, which have fairly large bolls that open wide and are easy to pick. Some of these hybrids have been bred in isolated patches for several years and carefully selected, so that at the present time they reproduce themselves nearly true to type. Some further selection is necessary before these varieties are ready for general cultivation, but they give promise of being of great value. The experiments started five years ago in the selection of certain standard short-staple varieties to increase the length of lint without hybridization have yielded somewhat striking results. Two experiments—one, a selection from Russell Big-Boll, and the other from Jones Improved—have yielded new types having lint averaging about one-fourth inch longer than the parental strains, while in other respects the varieties do not appear to be materially changed. From the tests thus far made these new varieties seem to be as productive as the ordinary standard short-staples, and produce a fiber of much greater value. Limited quantities of the seed of these two sorts will be placed with cooperative growers next season for trial and further seed propagation.

**EARLY VARIETIES FOR BOLL-WEEVIL DISTRICTS.**—The careful investigations conducted by the Department have shown that one of the factors of greatest importance in reducing the damage caused by the cotton boll weevil and bollworm is to use early-maturing, short-season varieties. The King, Shine, and Parker varieties, which are the best of this sort which now exist, are all unsatisfactory because of small size of bolls, short lint, etc. Varieties are greatly needed which are as early as the King, and have large bolls and good length of lint. Extensive breeding experiments are being carried on by Dr. D. N. Shoemaker, Prof. D. A. Saunders, Prof. S. M. Bain, and Mr. E. B. Boykin, of this Bureau, having as an object the production of such varieties. One new variety, the Edson, which has been produced by selections from a native type of cotton, is believed to be valuable. Seed of this variety has been distributed to numerous growers for trial this season, and the variety is being selected more carefully for further distribution. The King variety is being carefully selected to secure large-bolled types with longer and better lint, and the breeding patches of this variety show marked improvement in this direction. Several selections also show marked increase in storm-resisting qualities over the original parental variety, which drops its seed very easily. Selections for earliness and improvement in other characters have also been made from Hagaman, Parker, Bohemian, Triumph, Jones Improved, and other varieties, and in almost all cases, as would be expected, marked improvement has been secured, and some of the selections will doubtless result in valuable new strains. One of the selections from Triumph is being grown in considerable quantity this year to secure seed for distribution to planters.

In the group of cotton varieties known as long-staple Uplands, which are grown extensively in northern Texas, Louisiana, and Mississippi, all of the known varieties are late in season; and as the region where these cottons are grown is becoming infested with the boll weevil it is highly important that earlier varieties be produced. Many experiments are under way in this field, selections having been started in Texas, Louisiana, Mississippi, and South Carolina with the Griffin, Sunflower, Boozer, Fleming, Southern Hope, and Cook's Long-Staple varieties. Rapid progress is being made and it is certain that varieties showing great improvement will soon be ready for distribution.

In the cotton-breeding work conducted by the Bureau of Plant Industry in cooperation with the Texas Agricultural Experiment Station, marked advances have been made. Prof. R. L. Bennett, the investigator in charge, reports that a count of mature bolls on cotton plants grown from seed selected for early and rapid fruiting showed, on July 26, 1906, an increase in earliness of 25 per cent over plants of ordinary varieties. This gain is reported as greatest in the selections made to develop a cotton for rich bottom lands infested with the weevil, but it is also very plain in the selection of seed made especially to secure early varieties for hill and upland regions.

**PEDIGREE STRAINS OF SHORT-STAPLE VARIETIES.**—It is of the highest importance to the cotton planter to use seed of good quality which has been carefully bred to a high degree of efficiency in production.



In order to educate growers to the importance of using carefully bred pedigree seed, several of the ordinary short-staple varieties of cotton have been systematically selected to increase the yield, and seed of such improved strains is being placed in the hands of growers as rapidly as possible for trial. Last spring packages of this highly selected seed, through cooperation with the Office of Seed and Plant Introduction and Distribution, were placed with about 4,000 planters in various parts of the South. Very marked improvements in vigor and yield have been secured in selections of the Pride of Georgia variety, and it is the pedigree seed of this sort mainly that has been distributed. The selection has been continued and more highly select seed will be distributed the present season. Several other varieties are under selection for increased production and will soon be ready for distribution to planters.

#### CORN INVESTIGATIONS.

The corn-breeding work conducted by Mr. C. P. Hartley, assisted by Mr. Ernest B. Brown, has yielded highly profitable results. There has recently been a great increase in the demand for seed of improved strains of corn, and through the cooperation of the corn breeders' associations recently organized in many States, the American Breeders' Association, the State experiment stations, and individual corn breeders there is now available a very much better quality of seed corn than existed a year ago.

**SELECTION WORK.**—With the object of producing highly productive strains of corn suited to sections of different soil and climate conditions, work has continued with the strains being bred in the Mississippi Valley between the thirty-first and forty-third degrees of latitude, and in Virginia and Maryland, adjacent to Washington, D. C. One of the strains that is being bred in Maryland, in a duplicated variety test of that made on the Potomac Flats last year, out-yielded all the best known varieties from various parts of the United States; while a strain that has been subjected to selection work for four years in Ohio has shown a yearly gain of 10 bushels per acre over the yearly production of the original corn grown under the same conditions. The figures would speak even more strongly in favor of the selection work but for the fact that the original corn as grown yearly, to the extent of 700 acres, has been much improved by taking as much seed as possible each year from the 10-acre breeding plot after the best has been selected for breeding work. Seed of these improved strains has been furnished in lots of 15 or 20 ears to several hundred farmers in sections to which these strains were adapted or thought to be adapted, and some exceedingly good reports have been received regarding the germination of the seed, vigor of growth, and productiveness.

There is great need of such work in the extreme northern portion of the United States, where continued growing of small grains has reduced the yield to a degree of unprofitableness and where a cultivated crop, such as corn, is needed in rotation. The same applies to California and other portions of the West. Some very early maturing varieties are being tried in 8-acre plots on twenty California

farms to test the profitableness of growing them on unirrigated land in rotation with wheat. Previous trials have shown that these varieties are sufficiently early to produce grain before the land becomes too dry to prevent growth.

**TESTS OF VARIETIES.**—The tests of the leading varieties of early corn begun in 1905 in cooperation with fourteen of the experiment stations of the Northern States and with interested farmers are to be continued for three more seasons. The results of last year's tests have already proved very valuable. One more season's work will complete a five years' test of fourteen of the leading varieties of medium and late maturity in cooperation with fourteen experiment stations of the Central and Southern States. The results thus far are generally in favor of the varieties the seed of which was obtained from the section near where the tests were conducted.

Numerous corns from Mexico, South America, Bulgaria, Hungary, Russia, Africa, and other countries have been tested, but most of them are not as desirable as our native varieties. Some of them, especially Mexican and South American varieties, possess to a degree the ability to withstand drought, and it is hoped that means will be provided for improving these and adapting them to sections of little summer rainfall. A portion of an ear of slate-colored rice popcorn obtained by Mr. T. H. Kearney, of this office, in Algeria, but said to have come from Morocco, has produced so well and exhibited such marked uniformity that it is being tested further.

**WORK ON SWEET CORN.**—The breeding work with sweet corn, having as its object the improvement of strains for canning purposes, has been continued in cooperation with a canning company in New York and one in Ohio, with good success. It has been demonstrated at these points that an excellent quality of sweet-corn seed can be grown and that with good care it will germinate much better and produce better than such seed as has customarily been purchased from other States. Work was this year begun in cooperation with the Bureau of Chemistry and with the experiment stations of Florida, South Carolina, Maryland, Connecticut, and Maine for the purpose of determining the influence of climate upon sugar formation in sweet corn. In the prosecution of this work it is hoped to develop improved strains of sweet corn for these States and at the same time to ascertain the effect of climate independently and as influenced by breeding for high sugar content.

#### BREEDING IMPROVED OAT VARIETIES.

The work on oat breeding conducted by Mr. J. B. Norton, assistant physiologist, is now far enough along to make some definite predictions as to results.

**NEW HYBRIDS.**—The most promising features in the breeding work at present are the new hybrids, now fixed in type and being selected for higher yields. Several of the selected crosses appear to be very desirable, as, for instance, Burt crossed with Clydesdale and Sixty-Day crossed with Probsteier and with Clydesdale. These series of crosses have yielded many large-grained early varieties with the vigor

and size of the late parent, and these new early varieties bid fair to succeed all the early varieties grown throughout the central Mississippi region.

The Sixty-Day and Kherson oats, introduced into this country within the last few years, are objectionable on account of their yellow color. Selections of white-grained plants have been obtained that possess all the good qualities of the parent sorts, and in a few seasons these will be ready for distribution. Many other selections and hybrids could be mentioned, but the foregoing furnish possibilities enough to make a decided change in the oat crop wherever it does not pay a good profit on account of smut, rust, hot weather blight, lodging, or other factors.

**SELECTIONS FOR DISEASE RESISTANCE.**—The past season has shown definitely that there is resistance to smut in oat varieties, and one selection from Burt has proved very smut proof. This resistance is all the more marked when it is remembered that this selection was grown alongside of smutted sorts for the last three years and has never been treated. Resistance to leaf-rust and retarded development of stem-rust were shown strikingly this year in selections of the Texas Red or Red Rustproof variety. As usual, the early oats escaped the serious effects of rust, dry weather, stem breaking, etc. On account of drought this season there was no lodging in the trial plats.

**WINTER AND SPRING OATS.**—Selections of winter oats have been made again this season, with the hope of extending the range of this crop to the north. The stock of winter-resistant selections made in 1904 is to be tested in comparison with these new selections, and it is hoped that some definite advance can be recorded. Large quantities of winter oats will be sown in the region north of the present winter oat belt, with the hope that some few plants may live through and establish a hardy strain. The work with spring oats is to be extended to several trial stations in the transition oat belt where the new selections and hybrids of early oats can be definitely tested. It seems certain that many of them will prove of merit, as the conditions under which they have been grown since 1904 have been practically those of the transition belt.

#### ALKALI AND ARID PLANT BREEDING.

The investigations in the breeding of plants adapted to cultivation in alkali and arid regions have been carried on by Mr. T. H. Kearney, physiologist, assisted by Mr. L. L. Harter. The main aim of this work is to secure varieties of various crops more resistant to these adverse conditions. The problem has proved a very difficult one, but encouraging results have been secured and the work is being prosecuted vigorously.

**ALKALI-RESISTANT FIELD CROPS.**—Work is being continued in Utah and Arizona along the same lines as last year in the alkali resistance of various field crops, and arrangements are being made to extend it into Nevada and western Nebraska. Marked differences have been found in the resistance of different varieties of wheat, oats, barley,



sugar beets, and alfalfa. These variations have been confirmed, often in a striking way, by cultures in alkali soil under controlled laboratory conditions, the same crop plants and varieties being used as in the field work. Oats seem to be better adapted to alkali soils than are wheat and barley. Of a half dozen varieties of alfalfa tested the Oasis strain from North Africa is decidedly the most resistant. Some of the less generally known forage crops, such as horse beans, vetches, and bur clovers, give promise of good results in alkali soils. The breeding of alkali-resistant sugar beets, in cooperation with Dr. C. O. Townsend, pathologist in charge of Sugar Beet Investigations, is being continued. In cooperation with Mr. Karl F. Kellerman, physiologist in charge of Soil Bacteriology Investigations, an investigation has been undertaken of the behavior in alkali soils of the nitrogen-fixing organisms of leguminous plants.

**DROUGHT-RESISTANT FIELD CROPS.**—The work started by Prof. W. A. Wheeler, of the South Dakota Agricultural Experiment Station, at the Highmore, S. Dak., substation in breeding drought-resistant field crops, especially forage crops, has been made cooperative with the Bureau of Plant Industry. Considerable progress has already been made in securing improved and drought-resistant strains of sorghum, millets, alfalfa, red clover, timothy, wheat grasses, and *Bromus inermis*. Work has been begun with a number of other forage crops.

**COTTON FOR THE ARID SOUTHWEST.**—Breeding work to secure strains of cotton adapted to growing under irrigation in the arid Southwest is being carried on in the Colorado River Valley in Arizona. A series of long and short staple Upland, as well as Egyptian and Sea Island varieties, is being tested with a view to ascertaining which types are most promising as a basis for further improvement by breeding.

#### BREEDING IMPROVED TOBACCO VARIETIES.

The experiments in the breeding of tobacco, which are conducted by Mr. A. D. Shamel, physiologist, assisted by Messrs. W. W. Cobey and W. W. Garner, have already yielded several improved varieties which are now being generally cultivated, and have resulted in a very general improvement of the methods of selecting and separating seed.

**CONNECTICUT WRAPPER TOBACCOS.**—The work in Connecticut during the last season included the testing of many promising hybrids. Two hybrids of special merit have been described as the Brewer and Cooley hybrids. The Brewer is the result of a cross of the native Connecticut Broadleaf with the Cuban, while the Cooley resulted from crossing the native Havana Seed variety with Sumatra. These hybrids were found to have superior qualities for cigar-wrapper purposes as regards shape and size of leaves, venation, even and regular texture from the tip to the base of the leaves, and other characters which go to make up a valuable cigar-wrapper tobacco. They are being extensively tested during the present season by numerous growers.

In Connecticut the various types of imported Sumatra and Cuban tobaccos have been found to come uniformly true to type when

seed is saved under bag. It has been conclusively proved that by proper selection and bagging of the flower clusters for seed the most desirable types for cultivation under shade may be propagated from year to year. The two most important and best types found for this purpose have been propagated and named the "Uncle Sam Sumatra" and "Hazlewood Cuban" varieties, respectively. These varieties have been found to produce profitable yields of cigar-wrapper tobacco.

WRAPPER AND FILLER TOBACCOS IN THE SOUTH.—The experiments conducted in Florida by Mr. W. W. Cobey in the improvement of tobacco varieties have demonstrated the value of this work to growers. The Uncle Sam Sumatra, first selected in Connecticut, and other carefully selected strains of Sumatra have clearly demonstrated their superiority both in quality and yielding capacity to the ordinary Sumatra grown in Florida. Samples of seed of six carefully selected types were placed with twelve careful planters for trial. The crops grown from the select seed by the twelve different planters are far superior to the remainder of their crops and are decidedly the best crops of tobacco in the State. As a result of this demonstration of the value of the methods of selection and preservation of seed introduced by the Department of Agriculture, almost all of the large tobacco planters are this year using similar methods, and more than 50,000 paper bags have been used this summer by growers in covering the flower clusters of their select seed plants. Many hybrids have been made in the course of the experiments and some of them give evidence of being of considerable value.

Selections of Cuban-filler types made last year showed decided difference in the aroma and flavor of different individuals, and it is clearly possible to improve tobaccos in these characters. A large number of selections have been made this year from the best progenies of last year's selections.

MARYLAND SMOKING TOBACCOS.—Experiments in the improvement of the Maryland smoking tobaccos are being carried on in cooperation with the Maryland Experiment Station. Selections made to secure greater uniformity and increased yields have shown striking results. The fields of tobacco grown from select seed are believed to be the best tobacco grown in the State the present season. The improvement in uniformity and quality has been very marked, and, as in other cases cited previously, clearly shows the value of using careful methods of selection and improved pedigree types.

EXPERIMENTS IN IMPROVING METHODS.—One of the most difficult phases of the tobacco-breeding work is the careful testing of the comparative burning quality of samples of cigar tobacco and accurately determining and measuring the differences shown. Dr. W. W. Garner has devised during the year an apparatus for testing the burn of cigars accurately and another for testing the burn of strips of leaves. These machines will prove of great value in connection with the breeding work of the Department of Agriculture and of other institutions.

Investigations of the curing of tobacco have been undertaken, directed more especially toward the control of pole-burn by means of artificial heat. These investigations include the careful study of con-

ditions of curing, with a view to presenting to the growers a simple and practical means of testing the conditions and their control.

In connection with the work on cultural methods, considerable attention is being given to the securing by breeding and introduction of satisfactory cover crops to grow with tobacco. Vetches are being used mainly in the northern and central districts, and cowpeas, velvet beans, and other legumes in the South.

**DISEASES OF TOBACCO.**—In Connecticut a fungous disease (*Thelavia basicola*) attacking the roots of tobacco has been studied, and different methods have been tested of controlling the disease by sterilizing the seed beds. The results obtained indicate that the disease in the seed beds can be prevented by sterilizing the soil. A new method of steam sterilization of the seed beds has been devised and is being tested under field conditions.

The tobacco industry of the South is seriously threatened by the attacks of the root-knot worm, or nematode, and many valuable shaded fields have become so badly infested as to cause almost a total loss of the crop. Careful breeding experiments were started several years ago in the production of resistant varieties, and some of the selections under trial have shown this year what appears to be decided resistance, three select types appearing to be almost wholly resistant. The indications now point very strongly to a favorable outcome of the experiments. More than 1,000 resistant selections have been made the present season.

#### MISCELLANEOUS BREEDING AND OTHER WORK.

In addition to the lines of plant breeding work previously discussed, various other subjects have received continued attention by the Office of Plant Breeding Investigations. Prominent among this work is the development of new types of citrus fruits and pineapples, under the personal direction of the physiologist in charge. A brief summary of the miscellaneous investigations conducted during the year follows:

**INTRODUCTION OF EGYPTIAN COTTONS.**—The experiments begun in 1900 in the introduction of Egyptian cottons are being continued. These cottons have been shown to require a long season for their development, and the experiments have, therefore, been conducted mainly in Florida during the past year, in cooperation with the Florida Experiment Station. Most of the varieties have been found to be very susceptible to the disease known as black-arm, and it is becoming evident that if the cotton is to succeed in the United States entirely new varieties must be bred of hardier, disease-resistant constitution, and shorter season.

**CITRUS BREEDING EXPERIMENTS.**—The experiments in the improvement of citrus fruits have proved very successful, and many valuable new sorts have been produced. The new hardy oranges or citranges, the Rusk and Willits, mentioned in last year's report, were again this spring distributed to numerous growers. A third citrange, having a much larger fruit than either the Rusk or Willits, has been named the Morton, and was described and illustrated in the Yearbook of the Department for 1905. Trees of this variety were



also distributed in considerable quantity in the spring of 1906. Two other hardy hybrids which are believed to be valuable have fruited since the last report, and it is planned to name these varieties and distribute stock of them in the spring of 1907. These hardy oranges or citranges form an entirely new class of citrus fruits, and are believed to be of great value for cultivation as home fruits in the region from 300 to 400 miles north of the present orange belt. A number of other novel citrus fruits have been secured in the course of the experiments. The Sampson tangelo, a cross between the pomelo and tangerine orange, and two new tangerines, the Weshart and Trimble, were described in the 1904 Yearbook, and last spring these were distributed to growers. In the 1905 Yearbook two new limes, the Palmetto and Everglade, were described, and these will be placed in the hands of growers as rapidly as possible. Another new fruit, a cross of the common sweet orange and tangerine, has been secured, which is believed to possess considerable value. It is a loose-skinned fruit of very different quality from any similar fruit which we now have. A large number of the hybrids under test have not yet fruited, and other valuable new types will probably be secured.

**NEW PINEAPPLE VARIETIES.**—The pineapple breeding work, which was started in 1894 and is now nearing completion, forms an interesting illustration of the results that can be obtained by carefully planned experiments. The best varieties were selected and hybridized to secure certain definite combinations of parental characters. The high character of these hybrids in general, so far as quality is concerned, has been very surprising. Five new types which are believed to possess superior qualities have been selected and were described in the Yearbook for 1905. Several other new sorts have been selected, which will also be named and distributed to growers as early as possible. These new sorts possess many improved characters that are believed to fit them for general cultivation and to recommend them above other varieties now cultivated. Among them are a number of smooth or spineless leaved varieties, very distinct from the Smooth Cayenne, which was the only smooth-leaved variety cultivated when the experiments began.

**BREEDING OF SORGHUM AND BROOM CORN.**—Breeding work having for its object the development of saccharine broom corns and Kafir corns has proceeded far enough to demonstrate the possibility of producing strains that can be grown for the making of brooms and for grain, and at the same time contain as much sugar as sorghum and consequently serve as well for forage. The development of such plants is likely to result in their displacing the nonsaccharine sorghums. The production of improved strains of saccharine and nonsaccharine sorghums is of vast importance to the semiarid plains region, where these plants are the leading ones in cultivation because of their drought-resisting qualities.

#### PLANS FOR FUTURE WORK.

The majority of breeding investigations outlined require to be continued on the same lines as last year. The pineapple experiments will probably be completed during the year, and no advanced work on this subject is being planned. The citrus breeding investigations

will be continued until all of the hybrids under cultivation have fruited. It is planned to have experimental orchards of second generation hybrids of the hardy types planted in some of the Southern States, probably in cooperation with the State experiment stations. A great advance is expected from the breeding of these second generation hybrids.

**COTTON.**—The cotton-breeding work will be continued on the problems under investigation. Special attention will be given in the future to the organizing of cooperative cotton-seed breeders in cooperation with the State experiment stations. This is rapidly becoming necessary in connection with the work in order to introduce and extend the cultivation of the improved varieties that are being developed by the Department. Unless handled by careful seed breeders and kept pure they are certain to deteriorate rapidly.

**CORN AND OATS.**—In the corn breeding investigations it is planned to give special attention to the development of the improved strains which have been secured. The importance of producing strains adapted to southern and extreme northern conditions is becoming more evident as the investigations proceed. The oat investigations will be continued along the lines outlined in this report. Special attention will be devoted to the breeding of more hardy winter varieties, as this is clearly one of the most important problems. The improved races which have been secured will be propagated as rapidly as possible in order to secure seed for distribution.

**ALKALI AND DROUGHT RESISTANT CROPS.**—The work on the breeding of plants for alkali and arid regions will be confined to a few localities that offer the best conditions and allow the work to be pushed most rapidly. It is planned to considerably increase the work which has been started in securing more drought-resistant sorts of grains and forage plants and to take up this work at one of the more southern stations in the Great Plains area. This is believed to be one of the most important breeding problems receiving attention.

**TOBACCO.**—The tobacco problems under investigation in Connecticut, Maryland, and Florida will be continued and extended as available funds permit. Seed of the various improved strains will be placed with growers this season in considerable quantity. The investigations will be extended to Kentucky, Tennessee, and Ohio, where it is of the highest importance to produce more productive strains and to introduce improved methods of seed selection and preservation. Similar experiments will also be undertaken in Virginia with the various varieties cultivated in that section. The study of pole-burn and other problems in connection with the curing and fermentation of tobacco and the experiments in producing disease-resistant strains will be prosecuted as rapidly as possible.

**MISCELLANEOUS FORAGE PLANTS.**—Incidentally, in connection with other investigations, considerable work has been begun on various forage-plant breeding problems, experiments having been started with alfalfa, sorghum, timothy, vetch, etc. Many problems of the greatest importance are presented in these lines, and it is planned to extend the work as rapidly as possible.

**PLANT LIFE HISTORY INVESTIGATIONS.**

The Plant Life History Investigations of the Bureau are under the immediate charge of Mr. Walter T. Swingle, physiologist, assisted by Mr. Charles J. Brand. The various subjects under investigation during the past year and the results accomplished are outlined in the following:

**DATE PALM.**—During the past fiscal year considerable attention has been given to life history investigations of the date palm. In cooperation with the Office of Seed and Plant Introduction and Distribution there have been established within the past few years three cooperative date gardens—at Tempe and Yuma, Ariz., and Mecca, Cal.—which are being conducted in cooperation with the experiment stations of Arizona and California. Two of these gardens contain far more varieties than are to be found in any one oasis in the Old World. The garden at Tempe, established in 1900, contains 483 palms of 147 different varieties; that at Yuma, which was established in 1905, contains 95 palms of 45 varieties, while the garden at Mecca, which has been in existence since 1904, consists of 394 palms of 90 varieties. In addition to these gardens, experiments are being carried on in cooperation with private growers in California, Arizona, and Texas, to whom from 1 to 30 offshoots have been sent, with the understanding that one-half are to be the property of the Department of Agriculture and that they shall permit inspection of these palms and the taking of fruit for study at any time.

It is essential for the proper development of date culture that the life-history requirements of the different varieties be worked out as soon as possible, in order that prospective growers may be advised as to which sorts are most likely to succeed in their locality. This work has been very much facilitated by the detailed studies made by Mr. Thomas H. Kearney, of Plant Breeding Investigations, of the varieties which are cultivated in southern Tunis, and which he has described in Bulletin No. 92 of the Bureau of Plant Industry. This work has been done in close cooperation with this office and that of Seed and Plant Introduction and Distribution.

The keeping track of so many imported varieties has proved to be a very serious task. Nearly all have Arabic names, and, unfortunately, the Arabic spelling varies greatly in different oases, while some of the Arabian merchants with whom Europeans are most likely to deal have very little first-hand knowledge of varieties, although the cultivators themselves very rarely make a mistake. The result is that a number of varieties, some of them of very great importance, have been received without labels or with labels which are obviously wrong. It has become a matter of importance to straighten out the nomenclature of these different varieties, and to this end a collection of authentic-named specimens of all the principal varieties is being accumulated as rapidly as possible.

A discovery of some importance has been made during the year, showing that the ripening of the date is effected by certain changes in the layer of enormously enlarged cells situated just below the skin. These giant cells vary in shape and size for different varieties, and also show variations depending on the degree of maturity of the



date and how long it has been kept. Investigations of these giant cells are now being made, which promise to yield very interesting results, besides being of much practical importance in distinguishing closely allied varieties and in judging the effect of the different artificial methods of ripening and curing the date.

**CLOVER AND ALFALFA.**—The investigations in the life history of these staple crops, which are of vital importance to farmers over the whole United States, are carried on by Mr. Charles J. Brand, assistant physiologist. Originally planned in 1904 to determine the effects of change of seed and the variations in the life history requirements of various strains of clover, the striking results obtained led to the extension in 1905 of the same methods to the even more important crop, alfalfa. It has been found that a great lack of knowledge has prevailed as to the soil, climatic, and cultural requirements of these crops, which are the backbone of agriculture in temperate climates. Both clover and alfalfa have been found to comprise very distinct forms, some meriting varietal or even specific rank. It has been found necessary to examine in detail the life history of these strikingly diverse types, heretofore ignored or considered to be merely strains of common clover or alfalfa. The scientific study of these new races of the two staple forage crops has completely changed our ideas as to their requirements and will in time undoubtedly bring about great changes in their utilization in practical farming.

The first results of this new line of work are presented by Mr. Brand in Bulletin No. 95 of the Bureau of Plant Industry, in which he describes a new race of clover, of Russian origin, which far out-yields the ordinary types in the North Central and Northwestern States. This new "Orel clover" is so distinct as to demand recognition as a new botanical variety and has life history requirements differing widely from those of the ordinary red clover. This type and other races will be studied until they are used in ordinary farm practice in the regions where they succeed best, so that loss and disappointment in the attempt to grow them in regions to which they are not suited will be prevented.

The extensive experiments under field conditions have shown that in very many cases change of seed of ordinary red clover gives increased yield. In no case in any of the sixteen stations located in ten different States did the home-grown seed yield more than seed from another region. Whether it will pay to change seed is largely a question of cost of seed and of certainty of getting seed from the locality desired.

In the work on alfalfa enough has been done to show that, as in the case of red clover, alfalfa comprises a number of very diverse races, differing widely in their soil, climatic, and cultural needs, and, what is even more important, differing markedly in their ability to withstand drought, extreme heat, alkali, bad drainage, etc. A thorough study of the principal types of alfalfa is now in progress and a preliminary report is being prepared.

The most striking result of the life history investigations of alfalfa has been the discovery of the existence of a drought-resistant type in some of the older centers of dry-land farming in Utah. Doubtless years of struggle against drought has led there to the preservation of only the most drought-resistant plants, whereas such strains would be

likely to be less vigorous under irrigation and be crowded out by strains needing more moisture. The importance of the results obtained this year has led to the inauguration of a special investigation of all available strains of drought-resistant alfalfa, and so promising are the results so far that a report is being prepared showing the bearing of these facts on dry farming.

Another factor of the greatest importance has been encountered in the dry culture of alfalfa. It has been found that even when the most drought-resistant forms are grown the margin between success and failure is sometimes so narrow as to be wholly determined by the cultural methods employed. For this reason the varying cultural requirements of the different races are being carefully studied and new methods of culture are being worked out.

**PISTACHE NUT.**—During the past year the investigation of the pistache and the wild stocks upon which it can be grafted has been given much attention. A large number of seedling pistaches belonging to several species are being grown at the Plant Introduction Garden at Chico, Cal. Some ten thousand stocks were ready for distribution last spring and about six thousand were sent out, mostly to fruit growers in California who were anxious to test the new nut culture. Some of the stocks were also distributed in Texas, Utah, Nevada, Oregon, and Washington. The life history investigations of this nut have shown that much weight must be given to the question of suitable stocks. To this end a study has been made of the wild pistaches of the whole world, resulting in the discovery of several new species, one of which occurs within the limits of the United States. It has been found that the wild pistaches are the largest and most sturdy trees that grow in the deserts of the Old World. In the Sahara Desert, on the arid slopes of the Euphrates in Asia Minor, and in the deserts of Baluchistan and Persia wild species of the pistache nut occur, all of these species being closely allied, though easily distinguishable. All of the characteristic desert trees attain very large size, and are naturally very promising in connection with the attempt to introduce pistache culture into the dry-land regions of the southwestern United States where irrigation is not feasible and where it is desirable to economize irrigation water as much as possible. In the course of these investigations it was learned that there are hardy varieties growing wild in central Asia which have never been introduced into culture in Europe or America. These have now been secured, and it is believed that pistache nuts will ultimately be grown wherever peaches can stand the winter in the States west of the one hundredth meridian. Such wild, hardy pistaches are of small size, although often of good flavor and color. It is thought that by hybridization and selection a hardy nut can be developed which will be large and of as good color as the more tender sorts now in cultivation.

In cooperation with the Office of Seed and Plant Introduction and Distribution, Mr. Thomas H. Kearney, acting on behalf of this Office, secured the best commercial varieties grown in Sicily, where the best grade of pistache nuts is now produced. The best sorts grown in Asia Minor, where pistaches are consumed as a dessert nut, roasted and salted like almonds, have been secured and are available for distribution to cultivators who have set out stocks. The investigation of the pistache nut has shown the value of making a study of the whole

group to which a new economic plant belongs. In the course of this work many valuable suggestions have been obtained as to the culture of tree crops in dry land regions.

**CROPS FOR DRY LAND REGIONS.**—The work on crops adapted to dry land agriculture has been devoted mainly to two lines, (1) the investigation of the drought resistance of dry land crops, and (2) investigations of tree crops suitable for growth in unirrigated and semi-arid regions. Until the drought resistance of the different varieties of Kafir corn and other sorghums, wheat, barley, oats, etc., can be determined with some degree of accuracy, cultivators are necessarily exposed to grave losses through cultivating varieties not sufficiently drought resistant to meet their climatic requirements. It is believed to be possible to determine with considerable accuracy the drought resistance of the principal crops and to make tests whereby this quality can be accurately determined. An unexpected result of these investigations is to show that heat requirements may often play as vital a part as drought resistance in determining the success or failure of a dry land crop.

In reference to the second line of investigation, it is believed that dry land agriculture can not be said to be on a satisfactory basis until tree crops as well as ordinary cereals and forage plants are grown. Trees suitable for growth in dry land regions must be deep rooted or have a very wide-spreading root system, and be able to bear crops in seasons so dry that ordinary shallow-rooted annual crops are almost a complete failure. To this new line of research the name "dry land arboriculture" has been given. It is hoped through these investigations to find not only fruit and nut trees suitable for growth in all regions where dry land farming can be practiced, but also to find trees yielding stock food and even forage. Such tree crops can replace oats for horses, for instance, and in emergencies even hay or pasture for other stock. Then, too, the question of shade and ornamental trees is important to the proper development of home life in dry land regions. Much of the bleakness of the average dry land farm is wholly unnecessary. Shade trees could be found which would beautify the home, and at the same time protect it from the otherwise unimpeded sweep of the wind. It is intended to make demonstration plantings of some of the most drought-resistant tree crops in such localities.

#### **SOIL BACTERIOLOGY AND WATER PURIFICATION INVESTIGATIONS.**

The former Laboratory of Plant Physiology has been given the title of Soil Bacteriology and Water Purification Investigations, and placed under the immediate charge of Mr. Karl F. Kellerman, physiologist. The various projects formerly undertaken have been continued, although the distribution of cultures for the inoculation of leguminous crops has not required as much of the time of the members of the staff as during the preceding year. In consequence it has been possible to devote more energy to experimental work in water purification and sewage disposal.



## SOIL BACTERIOLOGY INVESTIGATIONS.

**DISTRIBUTION OF NODULE-FORMING BACTERIA.**—During the year approximately 15,000 pure cultures for inoculating various species of legumes were distributed in hermetically sealed tubes and bottles. It is planned to distribute during the current year larger cultures to the farmers and thus render it possible to reduce the time formerly required to develop a rich culture for inoculating leguminous crops. It will also be possible during the coming year to complete the studies on the chances of contaminating and rendering useless cultures that are apparently good.

**FIELD EXPERIMENTS WITH NODULE-FORMING BACTERIA.**—A careful system of supervision of inoculated fields has been arranged during the year. Cooperative tests are being carried on with Prof. C. V. Piper, agrostologist of the Office of Seed and Plant Introduction and Distribution, especially in Maryland, New York, and Texas; with Mr. Thomas H. Kearney, of Plant Breeding Investigations, in Utah; and also in New York and Ohio with the experiment stations of those States. Many tests are also under way on large farms that can be visited by officers of the Bureau, and on several farms under the supervision of Mr. T. R. Robinson, assistant physiologist. It is hoped by this careful experimental work to acquire much valuable information concerning the best manner of treatment of certain soils and crops in order to obtain the most successful inoculations.

Extensive greenhouse tests have also been carried on in order to determine the relation between various types of soil and successful inoculation. This work is very suggestive and will probably give valuable data in regard to the influence of cultural methods on inoculation and the actual rôle of legumes in the system of rotation.

**MISCELLANEOUS PROBLEMS.**—Experiments to determine the relation of crop growth to bacterial growth have been made. Soil extracts of a particular soil used as culture solutions allow the development of nodule-forming organisms that seem to parallel very closely the development of the species of legume from which the bacteria were isolated. In this way it seems probable that the success or failure of a particular leguminous crop upon a particular field can be predicted with more or less accuracy.

Experimental work is being carried on with various soil organisms in order to determine the relation of bacterial flora to soil fertility.

## WATER PURIFICATION INVESTIGATIONS.

There has been a steady increase in the number of treatments with copper sulphate for destroying various species of algæ and bacteria of the colon type. A few of the reservoirs treated the previous year have required second treatments during the present year.

**USE OF COPPER SULPHATE IN SEWAGE DISPOSAL.**—Experimental work has been carried on at Vineland, N. J., the results of which seem to indicate that in small sewage plants the use of copper will make it possible to produce sewage effluents that are entirely free from pathogenic bacteria. Additional work is to be carried on throughout the United States in order to determine the value of copper in various types of water.

**BIONOMIC INVESTIGATIONS OF TROPICAL AND SUBTROPICAL PLANTS.**

These investigations are in charge of Mr. O. F. Cook, bionomist, who reports upon the following subjects receiving attention during the past fiscal year:

**WEEVIL-RESISTING CENTRAL AMERICAN COTTONS.**—Studies of the native cotton cultures of Guatemala and other weevil-infested regions of tropical America have resulted in the discovery of many indigenous varieties of cotton. These have been cultivated for long periods of time in the presence of the boll weevil and have developed numerous weevil-resisting adaptations. They are not perennial "tree" cottons, but are dwarf, short-season varieties of the Upland type, productive and of good quality. Experimental plantings have been made in Texas and other cotton-growing States to test the possibilities of utilizing these weevil-resisting characters in the United States, either by direct acclimatization of the best of the foreign types or by crossing with our Upland varieties.

**INDIAN CORN.**—An investigation of Indian corn in Central and South America has shown that a large and diverse series of varieties exists, with pronounced adaptations to local conditions and methods of culture. Such types of corn would be very valuable in the Gulf region and in the arid Southwest, where our northern varieties of corn do not thrive. Some of these varieties thrive in moist tropical lowlands and others in arid and elevated regions.

**COFFEE.**—In the work on strictly tropical cultures, studies in Guatemala and Mexico have made it possible to outline a new system of coffee culture adapted to nonvolcanic regions, such as Porto Rico, whereby the life of the plantations under open culture can be extended by group planting and new methods of pruning and cultivation, which save labor and conserve the fertility of the soil. Attention has been given to the methods of pruning in use in several diverse regions of coffee culture. The facts which have been brought to light by these comparative studies will allow pruning practices to be greatly improved and to be based on scientific principles and adapted to the needs of different conditions. Experience has shown that methods most advantageous in one district may be actually destructive in another.

**RUBBER.**—The study of the Central American rubber tree has been extended into the eastern district of the State of Chiapas, Mexico. The plantations are still too young to warrant the drawing of conclusions regarding the general prospects of commercial cultures of Castilla, but they are old enough to show conclusively that this tree, like most others, responds very definitely to differences of climate and soil. Under sufficiently favorable conditions the prospects of successful rubber culture still remain good. The caution voiced in former years against general and indiscriminate rubber planting in advance of adequate agricultural knowledge appears more than ever justified, but the desirability of widespread experimental plantings in our tropical islands has not diminished.

**PLANS FOR FUTURE WORK.**—It is proposed to continue the canvass of the varieties of cotton that exist in weevil-infested countries and

to study the nature of their resistant adaptations. It has been learned that field cultures of cotton exist in southwestern Mexico and in Nicaragua, in the presence of the weevil, and these would seem to be promising fields for investigation. Central American varieties of cotton are to be planted in various parts of the cotton belt in order to gain more definite information regarding the various weevil-resisting adaptations and their application to different regions. The reactions of introduced varieties to climatic conditions will also be studied, with a view to making it possible to conduct future introduction and acclimatization experiments along more scientific lines, and to test the feasibility of extending this culture farther north and west. It is also desirable to give attention to the possibilities of cotton culture in Porto Rico, to learn whether some of the excellent Central American varieties may not be adapted to that island.

The study of the tropical varieties of corn will be continued, especially in Guatemala, where great diversity of forms has been found and where the special climatic adaptations are very pronounced. Coffee pruning, based on the dimorphism of the branches, will be tested on a larger scale, and the adaptation of coffee culture to the climatic conditions of Porto Rico will be studied. The study of rubber culture will be continued, and some of the older plantations which are now reported to be producing rubber in paying quantities will be visited.

#### **DRUG AND POISONOUS PLANT INVESTIGATIONS AND TEA CULTURE INVESTIGATIONS.**

The drug and poisonous plant investigations and the tea culture investigations of the Bureau are under the immediate charge of Dr. Rodney H. True, physiologist, who reports on the progress of the various lines of work as follows:

##### **DRUG PLANT INVESTIGATIONS.**

The work on drug plants has proceeded during the past year along the same general lines as heretofore. At Washington, D. C., the transfer of this work from the Potomac Flats to the Arlington Experimental Farm has been practically accomplished, and in so doing it has been necessary to abandon temporarily work on a number of plants. The unavoidable interference with perennials which transplantation brings has had its harmful effects. In addition to the plants which have been under study for the past few seasons, some special attention has been given to the sorts of chillies and red peppers known in American commerce. Methods of growing belladonna, digitalis, and a number of other drug plants have been worked out, and a publication embodying these results is being prepared.

**TESTING STATIONS.**—During the past year testing gardens have been maintained at Burlington, Vt., in cooperation with the Vermont Agricultural Experiment Station; on the Arlington Experimental Farm, near Washington, D. C.; at Ebenezer, S. C., in cooperation with growers, and on a smaller scale at Pierce, Tex. At these places, located so widely apart in regard to climatic conditions, a study of the behavior of promising drug plants is being carried on with reference



to yield, quality of product, and general adaptability. A number of kinds of plants thus under observation seem worthy of a larger test with reference to their commercial possibilities.

**ASIATIC POPPY.**—At Burlington the Asiatic poppy gives good results, a very destructive disease that formerly threatened this crop having been practically stamped out by seed selection. At Pierce, Tex., a small planting of the Asiatic poppy gave a small amount of material, which will suffice to give information on the alkaloidal content.

The poppy work, however, has not made the desired progress. An attempt to get a sufficient amount of poppy material for a test on a commercial scale was made by cooperating with seed growers at Coyote and Oakley, Cal. In both cases practically the entire crop was lost.

**CAMPHOR.**—The camphor work has progressed somewhat rapidly. Through the courtesy of Dr. George E. Walker, of Huntington, Fla., and Mrs. Henry Hubbard, of Detroit, Mich., a quantity of camphor trees of various ages has been placed at the disposal of the Department for experimental work. More than 30 pounds of camphor were prepared, which on purification gave very favorable results. Tests of a scientific nature showed the identity of this product with that of the Orient. Tests in factory processes in which camphor is a necessary constituent were also satisfactory. A careful survey of the camphor trees now widely scattered throughout Florida, and of the conditions of soil, drainage, etc., in which they occur, has made it seem reasonably clear that camphor will flourish over a large part of the area from which frost has driven the orange industry.

**AMERICAN HOPS.**—At the present time American hops are the subject of invidious discrimination in many markets, due to the supposed lack of certain desirable qualities. A preliminary investigation of the conditions of growing, curing, and handling the product has been made, and the conclusion reached that the quality could be much improved by better methods of curing and cleaner picking. Accordingly, a study of the problems of curing has been mapped out and is now in progress in the hop districts of the Pacific coast.

**MISCELLANEOUS FIELD WORK.**—At Burlington, burdock and some other weed products have yielded good financial returns on a small scale. Studies of Seneca snakeroot (*Polygala senega*) have begun to show good results.

At Ebenezer, S. C., the commercial test of American wormseed (*Chenopodium anthelminticum*) resulted in an income comparing very favorably with that from the standard crops in like conditions. The income from a small field of paprika peppers grown from Hungarian seed was even more favorable, although the fact of an American source of the product forced a sale at a price considerably below that paid for the Hungarian article. A considerable local interest in this work has led to the enlargement of the experiment during the present season through the favorable terms of cooperation offered. Excessive rains, however, have interfered rather seriously with the prospects of this work during the current season.

**LABORATORY WORK.**—A laboratory study of the capsules of the Asiatic poppy as a source for morphine, codeine, etc., has been continued on material from various sources. It is proving practical on a larger laboratory scale, and strengthens the hope that a commercial factor of considerable importance may finally be developed. Material grown in central California gave a very favorable yield, and a more extensive test is desired.

The study of pinkroot has been concluded, and the summarized results have been published in Bulletin 100, Part V, of this Bureau. A list of the wild medicinal plants of the United States has been prepared and published as Bulletin No. 89, of the same series, embodying the most important information concerning the various plants listed. The demand for this publication warranted its reprinting in a second edition during the year.

In view of the present lack of standards of pungency in connection with the various kinds of red peppers, work has been carried on during the past year in the hope of establishing a practical method of judging pungency. This work at the beginning promises to be useful commercially and is to be continued.

**PLANS FOR FUTURE WORK.**—It will be desirable to continue in the future the testing gardens now maintained. In view of their utility in making it possible to ascertain some of the most important facts regarding the behavior of plants looked upon as commercial possibilities, it would be desirable to secure, in addition to the present locations, a station in some section of the Southwest, for the testing of valuable drug plants from similar localities in the Old World.

The camphor work promises well, and should be continued on a considerably increased scale in order to carry out work on methods of cultivation and handling. In view of the great promise of the work on the Asiatic poppy, further efforts will be made to secure a commercial test in some favorable locality. The work on hops, on account of the large interests involved, should be continued on a larger scale, it being desirable that a fairly well-equipped laboratory should be established in some region central to a large part of the hop industry. The problems involved are such as to make it necessary that green material should be studied as well as that which has been cured, thereby requiring such a laboratory. The work on drug plants in the laboratory at Washington will be continued as heretofore, running parallel to the field work.

#### POISONOUS PLANT INVESTIGATIONS.

The poisonous plant work has continued during the past year to be devoted to the same general subjects as during the year preceding. Principal attention, however, has been given to the disease in horses and cattle caused by various species of the so-called loco weeds.

**LOCO DISEASE.**—A careful feeding experiment on horses and cattle has been carried on at Hugo, Colo., in cooperation with the Colorado Agricultural Experiment Station during the range season. About fifty animals were divided into two lots and pastured under close observation in two fields, one of which had been freed from loco plants by careful digging, while the loco weeds had full possession

of the other field. This general experiment was supplemented by feeding experiments in corrals. The general outcome has shown very clearly that the so-called loco weeds (*Astragalus molissimus* Torr. and *Aragallus lambertii* (Pursh) Greene) are able to produce the symptoms characteristic of locoism and are unquestionably the chief cause of the immense loss to the stock-grazing interests of the Great Plains associated with the so-called loco disease. Autopsies on animals placed at the service of the Department's investigators have furnished valuable confirmatory evidence. Remedial measures are now being sought, as are also means of exterminating the weeds and methods of counteracting the poison.

Cooperative work between the Montana Agricultural Experiment Station and the Bureau of Plant Industry concerning the loco disease in sheep, as seen in Montana, seemed to indicate that the loco plants most abundant in Sweet Grass County (*Aragallus spicatus* (Hook) Rydb.) were hardly a chief factor in the trouble. In view of the conclusion so clearly warranted by the work in Colorado on cattle and horses, work on sheep has been begun at Hugo, Colo., with the loco plants there found. "Locoed" sheep surviving the Montana experiment were fed under observation at Bozeman, Mont., with the result that they were found to make good gains and to return a fair profit for handling. A bulletin of the Montana station presenting these results was issued during the last winter.

LARKSPUR POISONING.—Work on larkspur in cooperation with the Colorado Agricultural Experiment Station resulted largely in a confirmation of the conclusions reached by Mr. V. K. Chesnut, while in the Bureau of Plant Industry, regarding symptoms and methods of treatment. A bulletin embodying these results was issued last spring by the Colorado station. It was shown that the larkspur is decidedly more virulent in the early stages of its growth than after it comes into bloom.

LABORATORY WORK.—The laboratory work on poisonous plants has consisted in part of a continuation of the pharmacological studies on *Zygadenus*, the mountain laurel (*Kalmia latifolia*), and mistletoe. Chiefly, however, attention has been directed toward the loco weeds. It has been shown that several species are fatal poisons, whether taken in large doses in acute cases or in long-continued chronic cases produced by the administration of smaller doses for longer intervals. Experiments with extracts have demonstrated beyond doubt the correctness of the conclusions following the field work, that the loco weeds studied are the source in great part of the loco disease of the range. The approximate nature of the active principle has been ascertained. Thus a great forward step has been made toward obtaining a clear understanding of the causes of the great losses experienced by stockmen from the so-called loco disease.

PLANS FOR FUTURE WORK.—It is desirable to follow up as rapidly and as completely as possible the field and laboratory studies on the loco disease, in the hope of finding practicable methods of reducing the now very serious losses met by stockmen from this source. There is a loco disease on the mountains as well as on the plains, and there seems to be abundant evidence to direct suspicion against a large number of members of the genera *Astragalus* and *Aragallus*. It



seems necessary to test the poisonous properties of as many of the commoner species as possible in order to determine how many are dangerous plants. Feeding and laboratory experiments will be necessary to develop the facts. A study of the ecology of the loco plants is very necessary to determine the best methods of destroying them. Careful physiological studies are needed to determine the best methods of saving stock from the effects of eating loco. In order to carry on this work to as early a completion as possible additional animals and more assistance will be required.

#### TEA CULTURE INVESTIGATIONS.

The investigations for the purpose of determining the possibilities of the commercial production of tea in the United States have continued during the past year along the same general lines as heretofore. Following is a brief statement of the work of the year:

**WORK IN SOUTH CAROLINA.**—The work at "Pinehurst," Summer-ville, S. C., in cooperation with Dr. Charles U. Shepard, has been continued along lines looking toward the improvement of the quantity and quality of the product. The younger gardens have given an increased yield, as is naturally expected as the work progresses. During the last season, however, a change in the method of picking was tested which has contributed to this increase. Heretofore in plucking the young leaf the stem was broken just above the point of attachment of the second leaf, counting the bud as a leaf, and the upper two-thirds of the third leaf was taken. This involves a considerable laceration of the bush and necessitates the healing of these wounds. The other method tested involves the breaking of the soft stem just below the third structure, making but one wound on a tip. This method, in addition to offering a physiological advantage, utilizes more of the tissues available for tea making. As a result of all influences, the greatest yield yet seen at Pinehurst was obtained—something over 12,000 pounds of dry tea.

In the factory at Pinehurst some new machinery was tested. The compression of finely ground tea into tablets was attempted with a machine of the same general type as that used by manufacturing chemists, the result being that after a few trials a hard, slightly tablet was produced which readily disintegrates in hot water. The superior adaptability of this form of preparation for purposes where compactness is desired is apparent.

**EXPERIMENTS AT PIERCE, TEX.**—The area of land set to tea at Pierce, Tex., has been increased to 40 acres, but owing to the very unusual amount of water the land has been in part flooded and the plants have suffered severely or have been killed outright in places. A small lot of hand-made tea was prepared from the older plants last summer and tested. It is probable that the Texas teas will have a stronger flavor, with perhaps less delicacy than the Pinehurst tea. Further developments are awaited with interest.

**LABORATORY WORK.**—During the past season laboratory studies have been continued along the lines reported last year, namely, (1) the relation between the price of teas and their constituents, and (2) the source of the aromatic qualities of tea. On the former problem

results have seemed to indicate the probability that neither caffeine nor tannin content stands in any direct relation to the price of the product. In the latter study it is established that the aromatic properties of tea are not due to volatile oils, as generally believed, but to other bodies the nature of which is not at this time definitely known.

**PLANS FOR FUTURE WORK.**—It is very desirable that during the ensuing fiscal year the work on tea in the field, factory, and laboratory be continued along the same lines as the work of the past year. The area at Pierce, Tex., should be extended until 100 acres of tea have been obtained. This will give sufficient area to employ a factory of moderate size. A continuation of the work on the relation between the constituents and the value of tea, and also concerning the sources of the aromatic properties of tea, is important in a commercial way and should be continued. The field problems, such as method of picking, are of very great importance and will be vigorously pushed.

### PHYSICAL LABORATORY.

The Physical Laboratory was organized practically at the beginning of the present fiscal year, with Dr. Lyman J. Briggs as physicist in charge.

**OBJECT OF THE LABORATORY.**—The Laboratory has for its object the devising of methods for the quantitative measurement of the physical and physiological factors which modify crop production, and the employment of such methods in determining the relation of environment to plant growth and the effects produced by different systems of crop rotation and methods of cultivation. Field work along these lines will be carried on during the next year in North Dakota, South Dakota, Nebraska, Kansas, and Texas in connection with the Great Plains cooperative cultivation experiments conducted by Mr. E. C. Chilcott. Systematic records will be kept of the rainfall and evaporation during the growing season, and the factors modifying crop growth will be carefully studied.

**SUBJECTS UNDER INVESTIGATION.**—An electrical method for the rapid measurement of the moisture content in grain is being developed in cooperation with the Seed Laboratory. Such a method, sufficiently rapid to determine the moisture content of grain without delay in transit will be of great value in connection with grain inspection.

A method for studying the transpiration of plants under field conditions is being developed in cooperation with Plant Breeding Investigations for the purpose of selecting drought-resistant strains of plants in the field. Cooperative work is also under way with the office mentioned in breeding alkali-resistant plants and in measuring the alkali resistance of various crops.

The influence of a strong electrostatic field on field crops will be investigated in cooperation with Plant Life History Investigations to determine whether plants can be made to mature earlier by this means or be profitably modified in other respects. The action of weak electric currents in stimulating plant growth and the effect of different forms of radiant energy on plant development will also be studied.

**TAXONOMIC INVESTIGATIONS.**

The Taxonomic Investigations of the Bureau include the work on fiber plants conducted by Mr. Lyster H. Dewey, botanist, and also the systematic botanical work and the collections of economic plants under the immediate charge of Mr. Frederick V. Coville, botanist. The work of the past year is summarized in the following:

**FIBER PLANT INVESTIGATIONS.**

The investigations of the different plant fibers have continued along the same general lines as heretofore, special attention being given to the following subjects:

**SISAL FIBER.**—Sisal being the most important in quantity as well as total value of any fiber, aside from cotton, used in this country, investigations have been carried on with a view to its production in the tropical possessions of the United States. The industry is already established in Hawaii. Investigations made of the production of sisal from the henequen plants in Yucatan, whence comes more than nine-tenths of the sisal of commerce, show that conditions similar to those of Yucatan exist in limited areas of Porto Rico. As it seemed impracticable to secure stock for propagation from Yucatan, an investigation was made of the sisal plants (*Agave rigida sisilana*) introduced from Yucatan into southern Florida, and the henequen plants (*Agave rigida elongata*) introduced from Yucatan into Cuba, and also of the cultivation of sisal in the Bahamas. The sisal plants growing without cultivation in Florida are of the same type as those cultivated in the Bahamas and Hawaii, while the henequen cultivated and also growing wild in old hedges in Cuba is of the same type as the henequen cultivated in Yucatan. Several thousand bulbils of the sisal plants of Florida, and also a quantity of bulbils and rooted suckers of the henequen plants of Cuba, were secured through cooperation with the Office of Seed and Plant Introduction and Distribution and sent to the agricultural experiment station at Mayaguez, P. R., where they are growing well.

During the current year plans have been made for an investigation of the Tamaulipas henequen of eastern Mexico and, if possible, of some of the fiber-producing mescal plants of western Mexico, these fibers being very similar to sisal. Henequen plants will be introduced into Hawaii, and through correspondence and publications information will be furnished tending to promote the sisal industries in Hawaii and Porto Rico.

**ABACÁ, OR MANILA HEMP.**—Abacá plants, producing the fiber known in commerce as "manila hemp," sent by the Office of Seed and Plant Introduction and Distribution to the experiment stations in Hawaii and Porto Rico are making a satisfactory growth. Their cultivation on a commercial scale in those islands is not recommended until it has been demonstrated that the fiber can be cleaned satisfactorily by machinery. Investigations along this line are being conducted.

**HEMP.**—The increasing cultivation of hemp in Nebraska, Minnesota, California, and Oregon, partly as a result of the introduction of a successful hemp brake, is developing an increased demand for



hemp seed of good quality. Practically all of the cultivated hemp seed used in this country is produced in a restricted locality on the bottom lands along the Kentucky River, the supply being rather precarious and often insufficient. Numerous experiments with imported seed have failed to give good results. Arrangements will be made for cooperative experiments in the cultivation of hemp seed with a view not only to increase the quantity, but also to improve the quality.

FLAX.—The successful manufacture of binder twine from flax straw of flax grown primarily for seed production, developing a profitable market for the straw that has heretofore been of little or no value, or even destroyed by burning, is giving new life to the flax industry. Greater care is being taken in the cultivation of the crop in order to produce a better quality of straw. While binder twine is the most profitable product to be made from this material at the present time, and certainly the most useful for the farmers of the country, the attention given to the flax straw hitherto neglected in growing flax in the United States may be regarded as a most important step in advance, as it will doubtless lead to the production of other textile products from the fiber. Investigations of improved methods of handling the flax crop will be made during the current year, and the fiber will be studied with a view to the determination of standards for comparison.

RAMIE.—Ramie roots transplanted in May, 1905, in the testing garden made a good growth during the season, yielding two successive crops of stalks suitable for fiber production, and stalks not cut until October produced a crop of seed. Numerous inquiries regarding ramie have been answered during the year. The ramie plant can be grown successfully on suitable soils from Maryland to Georgia and Texas, and also in California, but its cultivation on a commercial scale is not recommended until it has been demonstrated that the fiber can be decorticated in a satisfactory manner and prepared for market at a total cost not exceeding 5 or 6 cents per pound, the price at which the hand-cleaned ramie fiber known as "China grass" may be laid down in this country. Information is being collected regarding various experimental plantings of ramie, and, so far as possible, investigations are being made of ramie decortivating machinery.

CLASSIFICATION OF COTTONS.—Mr. Fred J. Tyler, of this office, has continued his investigations on the botanical classification of cotton plants. More than 250 kinds of cottons were grown in 1905 at three different stations near Waco and Sherman, Tex., besides many perennial kinds at the Subtropical Laboratory at Miami, Fla. These plants were all carefully studied in the field and very full notes taken of the characters of identification or differences. Photographs, herbarium specimens, and specimens of the lint were also obtained for laboratory study and comparison during the winter. Many puzzling questions regarding the identity of species have been cleared up and considerable progress has been made on the classification of cultivated varieties. During the present season about 250 kinds of cottons are being grown for study on the Arlington Experimental Farm and also at Timmons ville, S. C. Most of these are of the American Upland type, and the seed was obtained, wherever possible, from the originators.

**FIBER SPECIMENS FOR SCHOOLS.**—The fiber exhibit of the Bureau of Plant Industry at the Louisiana Purchase Exposition consisted in part of commercial bales of the more important textile plant fibers, which were obtained with a view to their distribution afterwards to educational institutions. During the past year the bales have been broken up into small samples and these, labeled with the origin, method of preparation, and uses of the fiber, have been distributed in sets to schools in all parts of the United States.

#### SYSTEMATIC BOTANY AND ECONOMIC COLLECTIONS.

The work in systematic and economic botany has continued, as heretofore, in charge of Mr. Frederick V. Coville, botanist, who reports as follows upon the work of the year :

**BOTANICAL LITERATURE.**—During the past year a plan has been perfected to improve and enrich the botanical library facilities of the Government. The essential features of the plan are a joint catalogue of the botanical works in the various Government libraries of Washington, D. C., a joint purchasing arrangement between the libraries chiefly concerned, and a purchasing list of botanical works not in any of the Washington libraries, but especially desired for reference. The libraries most actively interested in this plan are the Library of Congress (including the Smithsonian Deposit), the library of the Department of Agriculture, and that of the National Museum. The plan has proved highly satisfactory not only to the botanists who use the books, but to the librarians who purchase and care for them. It prevents unnecessary duplication, is economical, promotes a knowledge of the books available, and gives a clearer idea of the books required. There is every probability that the plan will be extended to other departments of literature represented in the Government libraries.

**ECONOMIC BOTANICAL WORK.**—Steady progress has been made during the year in the work, mentioned in last year's report, of collating and editing Dr. Edward Palmer's notes on economic plants, made during his travels of more than thirty years as a botanical collector, chiefly in Mexico. The work during the past year on a manual of the grasses of North America has taken the form chiefly of a critical study of some of the difficult genera, especially *Panicum* and *Stipa*. The preparation of a flora of Alaska has progressed, but with such interruptions from other work that its completion has not been possible during the year.

**HERBARIUM OF CULTIVATED PLANTS.**—The economic botanical collections of the Bureau of Plant Industry, while containing a good representation of such economic groups as weeds, poisonous plants, medicinal plants, and fiber plants, have not contained an adequate representation of cultivated plants in general. During the past year a systematic plan has been developed and put into operation to supply this need. An effort has been made especially to secure specimens of cultivated plants under the names by which they are offered in the trade by nurserymen, seedsmen, and florists. From the unsatisfactory treatment of cultivated plants with which one in search of information is usually confronted in the literature of botany, it appears either that less attention has been paid by botanists to culti-

vated than to wild plants or that the greater difficulty in the classification of domesticated species has baffled botanical students. Certain it is that all the groups of investigators who deal with cultivated plants need better accounts of their classification. The collection now in progress should aid materially in the making of such critical studies.

### AGRONOMIC INVESTIGATIONS.

The lines of work of the Bureau of Plant Industry which deal with broad agricultural problems or industries and consist mainly of field investigation have been grouped under the general heading of Agronomic Investigations. The results accomplished during the past fiscal year in these branches of the Bureau's work are summarized in the following paragraphs:

### FARM MANAGEMENT INVESTIGATIONS.

The farm management investigations of the Bureau have been carried on, as heretofore, under the immediate direction of Prof. W. J. Spillman, agriculturist.

### FARM MANAGEMENT DISTRICTS.

In order to ascertain the prevailing types of farming in different sections of the country and the effect of these types on soil fertility and the prosperity of the farmer, to learn the crops best adapted to different soils and climates, to study the details of farm methods, and especially to determine the types of farming and the methods which give best results in each locality, a number of farm management districts were established, as outlined in the last report, and a representative of the Bureau placed in charge of the investigations in each of these districts. Brief accounts of the work of the year in these localities follow:

**COTTON BELT.**—Farm management districts Nos. 1, 2, 3, and 4 are located in the cotton-producing region. District No. 1 consists of the States of North Carolina, South Carolina, Georgia, and Florida, Mr. Harmon Benton, assistant agriculturist, being in charge of farm management investigations in this district. District No. 2 consists of the States of Alabama, Mississippi, and the cotton-producing sections of Tennessee, its work being conducted by Mr. M. A. Crosby, assistant agriculturist. District No. 3 consists of Louisiana, Arkansas, and two Congressional districts in northeastern Texas, its work during the past year having been in charge of Mr. D. A. Brodie, assistant agriculturist. Upon the assignment of Mr. Brodie to executive duties in the office of the Agriculturist, Mr. C. K. McClelland, of this office, was placed in charge of the work in this district. District No. 4 includes all those parts of the State of Texas not included in No. 3, and is in charge of Mr. C. W. Warburton, assistant agriculturist.

Agricultural conditions and problems are similar in all these districts, the principal differences being as follows: (1) The cotton boll weevil is present in most parts of Texas and a part of Louisiana and absent to the eastward; (2) in the western part of the cotton-growing section the land has not been cultivated so long, and is consequently



more productive; and (3) live-stock farming is better developed in western and northern Texas than in other parts of the cotton belt. The single-crop cotton-growing system is the prevailing type of farming. In certain restricted areas rice culture prevails to the exclusion of other crops, while in parts of Louisiana and Texas sugar cane monopolizes the attention of the farmer.

The presence of the boll weevil in some sections and the practical certainty that it will in the near future spread over the entire cotton country have rendered imperative the necessity for a change in the system of cotton farming. During the past year the efforts of this office have been directed almost wholly toward the greater diversification of crops in the South. Careful study has been given to the results of the work of the State experiment stations and to the experience of progressive farmers who have been trying to break away from the old system. Many successful farms have been found on which crops other than cotton are important sources of income. Particular effort has been made to encourage truck farming and fruit growing, and also various forms of live-stock farming. Working plans have been drawn for numerous farms representing all these types of diversified farming and many new crops have been planted on cotton farms in all parts of the South as the result of these efforts. In several localities alfalfa culture has been greatly extended; the area of cow-peas has increased in all the States, and the grasses which thrive best have received more attention. Truck growing has increased to a very great extent.

NEW YORK AND NEW ENGLAND.—Farm management district No. 5 includes New York and the New England States, being in charge of Mr. L. G. Dodge, of this office. The most striking feature of New England agriculture consists in the large proportion of land devoted to grass. Much of this land remains in meadow or pasture indefinitely, with little or no care. As a result yields are low and weeds are troublesome. The weeds which are most persistent and injurious are witch-grass (*Agropyron repens*), oxeye daisy (*Chrysanthemum leucanthemum*), orange hawkweed (*Hieracium aurantiacum*), and a species of Ranunculus or buttercup (*Ranunculus acris*). Observations made on the best farms in this section show that these weeds are not troublesome on farms that are properly managed. Where the rotation is such that grass lands are broken up and devoted to tilled crops every two or three years, and proper use is made of manure and fertilizers, weeds are easily controlled and the yields of all crops are satisfactory. Several farms have been found on which the hay crop produces three or four tons per acre, practically free from weeds, while on old grass lands the yield is usually about one ton per acre and consists largely of weeds.

A farm in Delaware County, N. Y., has been studied which shows that permanent grass lands, properly managed, can be kept fairly productive. This farm consists of 100 acres of permanent pasture and 100 acres of nearly permanent meadow. Each year about 15 acres of the poorest meadow is broken up, seeded to peas and oats for hay, and then seeded down again with grasses and clovers. On this farm are kept 90 dairy cows, 5 horses, and about 40 head of young stock. All the manure is carefully saved and spread on the grass land. In the spring the meadows are harrowed and about 1 pound of

clover seed per acre is sown. The farm is profitable and the average yield of hay is 2 tons per acre. During the present season 5 acres of meadow on this farm produced 15 tons of hay.

**PACIFIC NORTHWEST.**—Farm management district No. 6, in charge of Mr. Byron Hunter, assistant agriculturist, consists of the States of Oregon, Washington, and Idaho. Many important problems are presented in this comparatively new country, chief among which are those relating to suitable types of farming to conserve soil fertility, and to crops adapted to local conditions of soil and climate.

The Willamette Valley, in western Oregon, represents the oldest farming section in the district. The early type of farming was a single-crop system of wheat growing. Originally the soil was very productive, but in about sixty years its fertility had been reduced until wheat was no longer profitable. During the past decade important changes in the system of farming have occurred. Truck and fruit growing have developed into important features of farming, and many farms formerly devoted to wheat have been converted into dairy farms, with highly satisfactory results both as to the productivity of the soil and the income of the farmer.

The general type of rotation in use on successful stock farms in the Willamette Valley differs from the type found on stock farms in the Eastern States in two important particulars—(1) a small grain crop intervenes between sod and a cultivated crop, and (2) fall-sown grain precedes spring-sown grain after the cultivated crop. The common rotation in the East, which often takes the form corn, oats, wheat, grass and clover, thus, in western Oregon, takes the form oats or barley; corn, or potatoes, or roots; fall-sown wheat or rye; spring-sown oats; grass and clover.

In western Washington fruit and truck crops are more than usually important. Dairying and poultry raising are also prominent. The general prevalence of these types of farming and the excellent markets have resulted in a phenomenal increase in the value of farm lands. The best lands, where well situated with reference to markets, sell readily for from \$200 to \$300 per acre, thus illustrating the effect of good methods combined with excellent markets.

During the past year Mr. Hunter has prepared a bulletin on "Farm Practice with Forage Crops in Western Oregon and Western Washington," which has been issued as Bulletin No. 94 of the Bureau of Plant Industry. East of the Cascade Mountains in this district there are two distinct agricultural sections. One of these consists of the section in which irrigation is practiced, the other of upland prairies having sufficient rainfall for crop production without irrigation. On the irrigated lands fruit, truck crops, and alfalfa are the principal crops. The most serious problem is the proper utilization of the alfalfa crop. As alfalfa hay is not generally appreciated by city horse feeders, largely because they do not understand how to feed it, the price of hay is usually low. Dairying and other types of stock farming are not as general in the alfalfa section as might be desired. An attempt is being made to encourage live-stock farming, especially dairying, on these alfalfa lands, with a view to providing a profitable outlet for the crop, while at the same time the fertility of the land is conserved.

**NEW DISTRICTS.**—Along the western edge of the corn belt satisfactory types of farming have not as yet become general. There is too much exclusive grain growing and not enough production of forage, especially of leguminous crops or of live-stock products. The prevailing system is beginning to produce very apparent effects on the productivity of the soil and the Department of Agriculture is receiving many urgent calls for assistance from that section. Accordingly, Mr. J. A. Warren, of this office, has been assigned to study conditions in what is to be known as farm management district No. 7, consisting of the States of Kansas, Nebraska, Missouri, and Iowa, with a view to ascertaining the best cropping systems and types of farming for that section. Owing to a recent influx of immigration into the drier portions of Nebraska, and the consequent demand for information concerning crops and methods of tillage adapted to this section, Mr. Warren is devoting his time at present to a study of these newly settled areas.

The completion of certain lines of work and the transfer of others to other offices in the Bureau of Plant Industry have made it possible to secure funds for extending the farm management work into sections hitherto neglected. During the current year farm management investigations will be instituted in two new districts, Nos. 8 and 9. The former will include the States of Virginia, Maryland, and Delaware; while No. 9 will consist of Kentucky, West Virginia, and those parts of Tennessee outside of the cotton-growing region. The investigations to be undertaken in these States will relate to the types of farming prevailing and those producing the best results, crops adapted to different localities, and the details of farm practice, particularly on the most successful farms.

#### FARM PROBLEMS UNDER INVESTIGATION.

In connection with its work in the various districts outlined in the foregoing, the Office of Farm Management Investigations has devoted considerable attention during the year to the working out of various special problems connected with farm practice in different localities. The principal investigations in this line during the year are described in the following paragraphs:

**DIVERSIFICATION OF CROPS ON RICE LANDS.**—Although the reduction in the acreage of rice during the past two seasons has resulted in a marked advance in the price of this cereal, thus rendering its cultivation again profitable, the fact that the known area of good rice land in this country is far in excess of the possibilities of the rice market makes a knowledge of other systems of farming on rice lands highly important. Experiments to determine the adaptability of these lands to crops other than rice have continued during the past year. The results indicate that proper drainage is the most important problem connected with the diversification of crops on rice lands, at least along the Atlantic seaboard. Where the land can be sufficiently drained the list of crops that may be successfully grown is large and includes some of the most important crops. Alfalfa does well on these lands where they are sufficiently dry. Cotton has been grown successfully and onions seem to do especially well. Cowpeas, oats, teosinte, and a number of other forage crops can also be grown.



Should conditions in the future require it there is little doubt that successful farming can be conducted on these peculiar soils independently of rice culture.

**COST AND METHODS OF STORING SILAGE.**—During the past year Mr. Lyman Carrier, of this office, has studied the details of the storing of silage in the case of 21 silos. A careful record was made of the cost of each phase of the operation, the methods employed, the number of workmen, and the part performed by each. The cost per ton of harvesting, hauling, cutting, and storing silage varied from  $49\frac{1}{2}$  to 80 cents. This variation seems to depend more on the ability of the manager in charge than on any other factor. The proper division of labor is important. The best results were secured by those who were able to keep all the workmen busy and the machinery in order. The size of the load drawn from the field was one of the most important single factors, the larger the load the less being the expense. These studies will be repeated in other sections of the country this season.

**SOILING SYSTEMS.**—Mr. Carrier is also studying the practice of farmers in using the soiling system for summer feeding. The crops used, the areas sown, the dates when each crop is available, the best stage of each for soiling purposes, the relative value of different crops for use as green feed, and the details of methods of harvesting and feeding are being studied. It is found that soiling practice differs materially from the systems generally recommended. As many farms, especially those devoted to dairying, use this system of feeding, it will undoubtedly be possible to secure valuable information from this study.

**FORAGE CROPS FOR HOGS.**—During the latter part of the last fiscal year Mr. C. E. Quinn, of this office, began the study of farm practice in the use of forage crops in growing swine. His study has thus far been confined to Oklahoma and Kansas, where this system of hog farming is largely in vogue. Important results have already been secured. The most valuable forage for this purpose is alfalfa, with wheat for winter pasture. From central Kansas southward, wheat furnishes pasture throughout the winter and pasture is available every month in the year. For dry, hot periods in summer, when alfalfa grows very slowly, small areas of sorghum are generally sown. Good upland alfalfa carries 10 head of hogs per acre during summer. The area of wheat is usually sufficient to supply abundant pasture during winter. Alfalfa on good alluvial soil will carry 15 head of hogs per acre. These hogs are fed more or less corn at all times, and for a short period at the last a full ration of corn is given. With this system of pasturing, 10 bushels of corn produces a 200-pound hog at the age of 8 months. Farmers who follow this method of hog raising are exceedingly prosperous. The effect of the system on the price of land has been marked, good alfalfa land selling at from \$50 to \$100 per acre, according to location. The system maintains the productiveness of the land.

**METHODS OF MAINTAINING SOIL FERTILITY.**—During the past year Mr. L. C. Wilson, of this office, devoted his time to a study of farm practice in its relation to the maintenance of soil fertility. On the untimely death of Mr. Wilson, Mr. F. G. Allison was placed in charge of this work. The methods used on successful farms in handling

and using barnyard manure and the resulting effect on soil and crops are being studied. While this work is only fairly begun, it would seem that best results are secured by those farmers who apply manure to the land as fast as it is made. This is probably largely due to the fact that this system of handling manures renders it comparatively easy to save the liquid manure, which is known to contain about five-eighths of the total plant food of the excreta of farm animals.

The use of green manures is also being studied. Particular attention is given to the value of different crops for green manures, their places in the cropping system, and their effect on the soil and on succeeding crops. Attention is also given to the methods in use for preparing and using composts. Farm practice in the use of commercial fertilizer is an important feature in the investigations along this line. It is probable that a study of farm practice and its results in the use of commercial fertilizers will throw much light on this vexed question.

RELATION OF TYPES OF FARMING TO SOIL FERTILITY.—Several members of the staff of this office are pursuing investigations in the relation of types of farming to soil fertility. The fact that a given system, followed for many years, produces larger crops than it did formerly is conclusive evidence that it improves the productivity of the soil. Likewise, a system that produces smaller crops after a series of years impoverishes the land. Studies of systems of farm management during the year indicate that any system which does not provide for maintaining an abundant supply of humus in the soil is unsatisfactory. In some instances systems have been found that have improved the productivity of the soil with what would ordinarily be considered inadequate provision for humus making. In at least one important instance a crop of clover every third year, combined with the stubble of an oat crop and the vines from a crop of potatoes, had even increased productiveness. In this case large amounts of commercial fertilizers were used on the potatoes, but the influence of these fertilizers has not been determined. There is an undoubted relation between soil types and systems of farming required to keep the land productive. This relation will be studied during the ensuing year.

In cooperation with the Kentucky Agricultural Experiment Station a plat demonstration has been arranged to show the relation of legumes and the production and consumption of forage crops to the maintenance of productivity. It is intended to extend this work over a considerable period. These investigations will show the proportion of the crops that must be consumed on the farm to keep the land fertile for the particular soil type on which they are conducted.

FARM PRACTICE IN POTATO CULTURE.—As potatoes are one of the most important crops in the New England States, Mr. L. G. Dodge, in connection with more general studies in that section, is devoting particular attention to farm practice in the production of this crop. During the season the investigation will be extended into other potato-growing sections. The general results of potato culture in Aroostook County, Me., have been very satisfactory. The crop there is grown in rotation with oats and clover, and about 1,500 pounds

of fertilizer per acre are applied to the potatoes. This fertilizer contains about 3 per cent nitrogen, 7 per cent phosphoric acid, and 8 to 10 per cent potash. Under this system land has acquired a market value of about \$125 per acre.

In the vicinity of Freehold, N. J., a unique system is in vogue. In the autumn crimson clover is sown on potato land. This is plowed under in the spring for another crop of potatoes. Such a practice has been followed on some farms for the past ten years. Commercial fertilizers in large quantities are used. This system has been highly profitable, yields being generally from 300 to 500 bushels per acre, with occasional yields as high as 800 bushels. Whether such a system can be continued indefinitely remains to be determined, and this locality will be kept under observation for this purpose.

**EXTERMINATION OF JOHNSON GRASS.**—The agriculturist in charge has previously worked out methods of eradicating Johnson grass under certain conditions, and Mr. J. S. Cates, of this office, is now charged with a further study of the subject. During the present season he has determined that in old meadows and pastures the rootstocks of this pest develop only near the surface, and the grass may easily be eradicated by the methods previously worked out. In cultivated fields, however, the rootstocks penetrate much more deeply and other methods are necessary. On cultivated lands it has been found that Johnson grass rootstocks cut off at a depth of 18 inches have sprouted up again. Various methods of tillage as a means of killing the grass on cultivated land are being tested, as are also the various proprietary compounds sold as means of destroying Johnson grass. As yet all compounds tested have proved to be either wholly ineffective or entirely too expensive to justify their use. In one case an agent in making a demonstration which resulted in a large sale of his compound used the material at a rate that would cost \$500 per acre, and was greatly astonished when his attention was called to this fact.

**WINTER COVER CROPS FOR THE SOUTH.**—Several members of the office staff, including Mr. C. R. Ball, now of Grain Investigations, Mr. M. A. Crosby, and Mr. Harmon Benton, have given attention to winter cover crops for the South during the past few years. These studies have shown the great importance of the vetches in this connection. The great desideratum at present is a vetch that produces an abundance of seed that may easily be saved, and that will mature for hay or soiling in time to be out of the way for such crops as corn or cotton. Hairy vetch matures entirely too late for this purpose. The common vetch (*Vicia sativa*) is slightly earlier than hairy vetch, but not sufficiently early to meet the requirements. A small vetch (*Vicia angustifolia*) has been found in the hay fields of portions of Georgia and South Carolina that gives promise of some value, though its seed is not at present generally available. But clover has considerable value as a winter cover crop in the South and is frequently so used. A more extended use of it is being encouraged. The common cereals are used occasionally as cover crops, for which purpose they possess much value.

**HAY INVESTIGATIONS.**—During the past year considerable attention has been given to methods of curing and handling hay. In sections



where hay is low-priced only the least expensive methods can be followed and a poor quality of hay results. Where better prices prevail better methods are pursued and a better quality of hay is produced. The use of hay cocks in curing hay in sections where unfavorable weather occurs during the haying season is receiving attention. The relation between weight and volume of cured hay, the loss of weight in curing and in stored hay, the relation of methods of curing to feeding value, artificial methods of curing hay, and other related questions are being studied. These investigations are conducted by Mr. H. B. McClure.

**COARSE LEGUMES.**—Mr. M. A. Crosby, assistant agriculturist, has continued the study of farm practice with cowpeas, soy beans, peas, and vetches during the past year. Considerable information has been obtained concerning the adaptability of various varieties of these crops to different soil and climatic conditions, their places in cropping systems, and their value as hay, pasture, soiling, and cover crops. Mr. C. R. Ball, agronomist, formerly of this office, has completed his study of varieties of soy beans and cowpeas, and the results will soon be ready for submittal with a view to publication. The varieties of soy beans have been reduced to seventeen well-defined types, each of which has been assigned a name. The characteristics of each type have been accurately determined, and it is believed that the confusion heretofore existing among seedsmen and farmers concerning the varieties of this valuable crop may be obviated by the publication of the results of this study.

**GULF COAST CROPS.**—During the year the work with crops specially adapted to the Gulf coast region has been continued by Prof. S. M. Tracy, special agent. Important results have been obtained and are now ready to be submitted with a view to their publication in a bulletin under the title of "Forage Plants of the Gulf Coast." Many plants of Guinea grass are now on hand from seed grown last year. An abundant supply of cuttings of Para grass has been produced. Both of these grasses have shown special value for the region near the Gulf of Mexico, and a distribution of them will be made next season.

There are now on hand several promising annual varieties of cassava, produced from seed grown in this country. Some seedling plants last year produced from 12 to 14 pounds of roots and abundant seed. An attempt is now being made to secure valuable strains that produce varietal characters true to seed. That this can be done there is little room for doubt, in view of recent knowledge gained of the behavior of seedlings. If the effort is successful the two principal difficulties in the cultivation of cassava will be overcome, namely, the keeping of seed canes over winter and securing a perfect stand in the field. Studies of Hawaiian redtop (*Tricholaena rosea*) in Florida show this grass to be a valuable addition to the forage resources of Florida and perhaps other Southern States. This plant will receive special attention this season.

**FORAGE FOR BEEF CATTLE.**—Experiments to determine the relative value of different kinds of forage in the production of beef have continued in cooperation with the Missouri Agricultural Experiment Station. The results show conclusively that legumes, such as cow-

peas, clover, and alfalfa, are much superior to timothy hay and corn stover as winter feed for this class of stock. Incidentally it has been shown that the condition of the steer at the beginning of a feeding period is more important than his age. For instance, a thin 3-year-old of good constitution and breeding will produce gain more cheaply than a full-fleshed yearling.

Mr. J. S. Cotton, in connection with his study of range improvement, has undertaken a study of farm practice in the production of forage for beef cattle. This study is not yet sufficiently advanced to furnish valuable results. Mr. Cotton is also studying farm practice in the production of feed for sheep. This study began the past year and it is hoped may result in much additional knowledge concerning a type of farming which is again assuming importance in this country.

**AGRICULTURAL SURVEYS.**—During the present season a number of reconnoissances are being made in sections about which insufficient information is possessed to answer the numerous questions that come from recent settlers. In Colorado Mr. E. J. Iddings, of the Colorado Agricultural College, is making, in cooperation with this office, a study of types of farming that prevail in the various agricultural sections of that State, the crops best adapted to different localities, the dates of planting and harvesting crops, and the details of farm methods in the management of various crops. This work will continue only during the summer months.

In New Mexico thousands of immigrants are taking up new lands, many of them in sections where water is not available for irrigation. The demand for information concerning crops adapted to local conditions and types of farming most likely to prove successful is urgent. A similar survey is in progress in that Territory, and is conducted by Mr. E. Heringa. The northeastern section of Missouri consists, for the most part, of level prairie lands that have been devoted mainly to grain growing during the half century since they were brought under cultivation. This system of farming has resulted in a decrease in the productivity of the soil, and many progressive farmers in the region have adopted improved methods of farming. Mr. D. H. Doane is studying these conditions. In Whatcom County, Wash., which is the northwestern county of the United States, the soils are of glacial origin and exceedingly variable in character, and consequently, in their adaptability to crops, and the methods of tillage and manuring required for successful farming they are also very variable. Much new land is being brought under cultivation, and the demand for information concerning farming in that section is urgent. Arrangements have been made to institute an agricultural survey of this county.

#### RANGE AND CACTUS INVESTIGATIONS.

Investigations dealing with the care and management of native pastures and with the use of the cactus as a forage plant have been conducted along the same lines as last year by Mr. David Griffiths, who is assisted in the range work by Mr. J. S. Cotton. Following is a brief outline of the work of the year:

**RANGE INVESTIGATIONS IN ARIZONA.**—The work conducted in Arizona, in cooperation with the Territorial University, has progressed

far enough to prove that worn-out range lands in this Territory will gradually recuperate when properly handled. The 50 square miles of territory which were fenced in about three years ago are in very marked contrast with the open range on the outside. The fence line, for the greater part, can be traced from the mountain tops 5 miles away, so striking is the contrast between the growth inside and outside the inclosure. The conditions here are most trying, and if gains can be secured which are at all promising where the rainfall is so slight and the evaporation so intense, what may be expected in more favorable situations? The more valuable perennial grasses are, under protection, gradually asserting themselves, until there are indications that they will gain their former prominence and supremacy over the more weedy and less valuable species. Annual grasses of little real value have increased very perceptibly under the influence of heavy stocking, but these experiments have already proved that the more valuable perennial or "root" grasses, as they are commonly called, will again assert themselves if allowed a period of rest, and will doubtless maintain supremacy over the weedy annuals if the lands are not overcrowded with stock.

**RANGE MANAGEMENT IN WASHINGTON AND CALIFORNIA.**—In the States of Washington and California work has been continued in a study of range management, and advice has been given to ranchers and others in handling their pasture lands. The small moist meadows scattered throughout the Sierra Nevada Mountains furnish a large part of the feed after midsummer. These have been greatly depleted by overstocking. The seeding of these scattered areas, which ought to be very productive, has been attempted with fairly successful results in both California and Washington. Upon such steep grades as exist here and with such torrents of water as flow over the meadows periodically it is hazardous in many cases to loosen up the soil by any means of cultivation. It is necessary to reseed with some plant which is aggressive enough to compete with native, less valuable sedges and with weeds without disturbing the surface soil. Timothy appears to meet the requirements better than anything else. Orchard grass is also a very valuable species and thrives under cultivation in drier situations. Alsike clover, awnless brome grass, and one of the native bromes are also of some value.

**CACTUS INVESTIGATIONS.**—During the year two cactus-feeding experiments have been finished. The feeding of singed prickly pear to dairy cows upon the Sinclair ranch at San Antonio, Tex., proves that good results can be obtained with prickly pear as the only roughage. Rice bran, cotton-seed meal, and prickly pear, at a cost of 13 cents per day, produced from  $1\frac{1}{4}$  to  $1\frac{1}{2}$  pounds of butter. There appeared to be a little better result obtained with prickly pear than with sorghum hay as a roughage.

A carload of steers was fed upon a ration of prickly pear and cotton-seed meal upon the Colman ranch at Encinal, Tex. The results amply justify the practice prevalent in southern Texas of feeding cattle for market upon prickly pear and cotton-seed meal. In this experiment a daily gain of  $1\frac{3}{4}$  pounds per animal was secured at an expense of  $3\frac{1}{2}$  cents a pound.

Various other projects in connection with the cactus plant are in progress, the most important being chemical investigations and diges-



tion experiments in cooperation with the New Mexico Agricultural Experiment Station and culture experiments and the testing and improvement of varieties in Texas, New Mexico, Arizona, and California.

#### GRAIN INVESTIGATIONS.

The grain investigations of the Bureau, under the immediate direction of Mr. M. A. Carleton, cerealist, during the past fiscal year have been conducted in general along the following lines:

**WINTER GRAIN EXTENSION.**—The extension work on winter grains for the past year has been almost entirely in charge of Mr. L. A. Fitz, of this office, and has been conducted largely in cooperation with the Kansas Agricultural Experiment Station. During the year an increased knowledge concerning the adaptation of the Kharkof winter wheat has been gained, and its area of cultivation has been extended to the north and west. The further tests confirm the former work with regard to the greater hardiness and yield of this variety in comparison with other hard winter wheats. In addition to being well established as the hardiest winter grain in western and northern Kansas, there is now a considerable acreage of Kharkof wheat in Nebraska, while the variety has come through the winter in good condition at a number of points in South Dakota and southern North Dakota. Enough of this wheat is grown throughout the Middle West area to make it already a considerable factor in the milling and grain trade. It is about equal in milling quality to the well-known Turkey or Crimean wheat.

West of the one hundredth meridian it has not been found possible so far to grow winter wheat of any kind in ordinary seasons because of the drought. The durum wheat, which is at present the only class of wheat sufficiently drought resistant for this area, is usually spring sown. Adaptation and selection work has therefore been conducted during the year to improve the winter hardiness of certain durum varieties with the hope that they may be developed into winter wheats. It will take time to accomplish this end, but already much progress has been made, and in several instances fall-sown durum wheat has come through the winter with very little winter-killing.

An important accomplishment of the year in winter grains is the successful introduction of the Tennessee Winter barley into a number of localities in Kansas and southern Nebraska. The third season in trials of this barley has just closed, and each year it has been proved to be perfectly hardy through the winter, being equal in this respect to any of the varieties of hardy winter wheat. The same experiments have shown the great value of this variety in yield per acre. Spring-sown barleys in the same locality always yield 10 to 15 bushels per acre less than the Tennessee Winter. The quality of the grain in this variety is also much better, and much fall and winter pasturage is furnished in certain seasons by growing the winter barley. So much of this grain is now grown that seed is easily obtained from a number of good farmers.

**ADAPTATION OF WINTER OATS.**—Over a large part of the South it has long been known that spring-sown oats are of little value compared with winter varieties. The Department of Agriculture has therefore endeavored through several years of trial to establish hardier

varieties. So far the Culberson Winter has done the best, both from the standpoint of hardiness and that of quality. At present, however, a number of tests are being made of a newly developed variety which appears to be considerably hardier than the Culberson Winter and will no doubt make possible a further extension northward of the winter-oat area.

**DURUM WHEAT.**—As a general crop the durum wheat was fairly established about two years ago. Last year the entire production was at least 15 million bushels, and probably nearly 20 million bushels. Reliable reports have come from many portions of North Dakota and South Dakota indicating that over a large part of the durum-wheat area there has been an increase in acreage this year of at least 50 per cent over last year, and in a number of places of as much as 100 per cent. The crop of 1906 will therefore be very much larger than that of 1905. In the meantime the wheat has met with much more favor among millers and grain dealers, as it has become better known. The price per bushel improved very much during the year. At Duluth, Minn., during a large part of the winter the price on an export basis remained about equal to that of Manitoba Hard wheat, while for a time durum wheat was in greater demand for export than any other class of wheat.

For two years or more the greater part of the time given to the investigations of durum wheat has been employed in producing pure types of a few of the best varieties, such as the Kubanka, Marouani, and Velvet Don. The Kubanka is found to be much the best variety from the milling standpoint if it is to be used for bread flour, and therefore special attention has been given to the improvement of this variety. Sufficient seed is now to be obtained from a number of farmers who are growing the Kubanka, and it is recommended that seed of this variety be used wholly, so far as possible, throughout North and South Dakota and adjacent districts. Certain other varieties are better for the production of macaroni. In exporting the grain it should be clearly understood for what purpose it is to be used, whether for bread making in Germany and southeastern Europe or for making macaroni in France and Italy. The great difference in yields in favor of durum wheat over other varieties throughout the region where it is adapted continues each year. While the last two seasons have been extremely unfavorable for durum wheat, because of the unusual rainfall, nevertheless in the drier areas there has been no indication that the quality will deteriorate after introduction into this country.

**MILLING AND FEEDING VALUE OF INTRODUCED GRAINS.**—For some time chemical analyses and milling experiments have been conducted in connection with the introduction of new grains to determine their value in comparison with native varieties, the work being in charge of Dr. J. S. Chamberlain, physiological chemist, and conducted in cooperation with the Bureau of Chemistry. The milling and baking tests with durum wheat have been mentioned in previous reports. The work of the past year has been chiefly devoted to analyses of many kinds of oats and barley to determine their feeding value. Many results of interest have been obtained, some of which are somewhat surprising, but as a rule they have shown that these introduced varieties are of great value for feeding.

**WHEAT DETERIORATION.**—During the year the study of the causes of deterioration in the wheat kernel has been continued, both in the form of laboratory work and of experiments in the greenhouse. The work in this line is in charge of Dr. J. A. Le Clerc, physiological chemist, of the Bureau of Chemistry, and is conducted in cooperation with that Bureau. Many field observations have been made, particularly where the hard winter wheats and the durum wheats are grown in comparison, at the agricultural experiment stations of the Western States. It is believed that a clue has already been obtained to the cause of this deterioration. It is at least known that an oversupply of water is injurious, and that therefore there is often danger of applying too much water in cases of irrigation. More cases of "white spots" in the durum wheat and of "yellow berry" in winter wheat are found where wheat is irrigated than under dry farming. Experiments have been started for determining the effect of different fertilizers and different kinds of soil on the development of the kernel.

**WHEAT IMPROVEMENT IN CALIFORNIA.**—In California wheat rapidly deteriorates in gluten content, so that at present millers are obliged to import from other States a very large percentage of the wheat they use in grinding. During the past year work has been continued in cooperation with the California Experiment Station in the improvement of the wheat of this region by establishing varieties having a larger percentage of gluten. From the results of the year it appears that several new varieties of wheat now under experiment for two years are well adapted to the region and are much better in gluten content than is the usual California wheat. A series of rotations of wheat with leguminous crops was begun with the idea of increasing the quantity of humus in the soil, which would better enable a good variety of wheat, when once established, to preserve its quality. Investigations have also been made of methods of cultivation and harvesting, with results that have made it possible to point out defects in the present methods employed by farmers generally in the California wheat region.

**RUSTS AND SMUTS OF CEREALS.**—The investigations of grain rusts and smuts are in charge of Dr. E. M. Freeman, pathologist. Of the rust work there are three chief phases: (1) The segregation of the host plants upon which only the different forms of any cereal rust will live; (2) an attempt to obtain more information concerning the life history of the grain rusts; and (3) a continuation of studies of the rust resistance of varieties. One important result of the work is that much more evidence has been secured that wild barley (*Hordeum jubatum*) very commonly harbors the black stem-rust of wheat, which is by far the more injurious of the two wheat rusts. As this grass is very common almost wherever wheat is grown, and as the rust even in the summer stage may be found alive in any month of the winter, it is possible that the rust may spread rapidly throughout the country from these patches of wild barley. Indirectly, therefore, wild barley becomes an enemy to the wheat crop, and, so far as possible, should be exterminated and wheat sown far from its influence.

In the work on smuts of cereals special attention is being given to the loose smut of wheat, and an attempt made to learn much more of



its life history. In this connection observations of our own seem to confirm the idea published by other investigators that this smut is biennial, passing a large part of its existence within the grain, which, if so, would account for the fact that it does not succumb to the ordinary treatment for grain smuts. A treatment severe enough to kill the smut is likely also to injure the grain. In connection with these investigations of rusts and smuts it is now possible, by means of new apparatus recently obtained, to section the hardest wheat kernels or even rice kernels, an operation which heretofore could not easily be performed, and this allows a much more thorough study of the grain and its germination, being of much value in the study of these fungous parasites, particularly the smuts.

**RICE INVESTIGATIONS.**—Special studies of the different varieties of rice and their adaptation were begun two years ago, but it has only been possible up to the present time to establish these investigations on a solid basis. The work is being carried on in cooperation with the Louisiana Experiment Stations, under the immediate charge of Mr. H. E. Ney, of this office, and is conducted chiefly at Crowley, La. It is yet too early to give definite results of the field experiments. A thorough comparative study of the principal kinds of rice is being made, including the glutinous rices and other varieties adapted for special purposes. Experiments are conducted to show the effects on rice of the application of different fertilizers, at present an important consideration in the rice district. The time of application and the amount of water to be used in irrigation are being investigated. No uniformity in regard to these matters exists at present.

**ADAPTATION WORK WITH GRAIN SORGHUMS.**—The great importance of the sorghums as drought-resistant crops in the Southwest has long been known. During the past season special adaptation tests have been started with those varieties of the nonsaccharine sorghums that are of particular value for the grain in order to determine which are the most drought resistant and best adapted to certain districts, as, for example, extreme western Oklahoma and the Panhandle of Texas. This work is in charge of Mr. Carleton R. Ball, agronomist. From results to date it is inferred that the dwarf forms of milo are, in general, best for the production of seed on the high southwestern plains. Attempts are being made to improve certain varieties, particularly to obtain earlier strains of Kafir corn, in order that the crop may be able to mature at the highest elevations. It is, of course, expected also to develop more drought-resistant varieties. In connection with the adaptation work a thorough study of numerous varieties from different parts of the world is being made to determine their classification and interrelation.

**AMARILLO, TEX., EXPERIMENTAL FARM.**—For three years experiments with grains have been conducted in the Texas Panhandle, being carried on during 1904 and 1905 at Channing. This work is under the immediate charge of Mr. A. H. Leidigh, of this office, in cooperation with the Texas Agricultural Experiment Station. During the past season these experiments have been transferred to Amarillo, Tex., and are now being made in a much more thorough manner and on a larger scale, with abundant space for operations. Although the chief part of the work is with grains, a number of other crops are grown in connection with these and particularly in rotation.

A complete series of rotations of grains with legumes has been instituted. The special importance of the experiments at this place is due to the fact that the country has heretofore been strictly a grazing region and practically no attempts have been made at agriculture. Much of the work, therefore, is of the pioneer sort, and consists in determining whether crops can be successfully grown. During the three years' work several factors have been fairly well determined. It is known that certain cereal crops can be very successfully grown, but that dependence can be placed only upon drought-resistant varieties. Certain varieties of grains, such as Black Winter emmer, Galgalos wheat, Fretes wheat, and the Kubanka durum wheat, may be considered well established as to their adaptation. Dwarf milo and a few other varieties of grain sorghums are especially well adapted. Rather extensive experiments are being made with different varieties of corn to determine whether any variety can be depended upon for a fair crop at the altitude of the Texas Panhandle. A very important matter for that region is the effect of the manner of cultivating the soil on crop production, and an investigation of this subject in detail is being made. A comparative study of different rates of seeding per acre is found also to be necessary, and this study has already brought forth some valuable results.

**PLANS FOR FUTURE WORK.**—During the ensuing year attempts will be made to extend the area of successful winter grain cultivation farther northward and westward by developing or securing still hardier varieties. The adaptation and selection work with winter oats will be continued with a view not only of making such oats perfectly hardy in Maryland and Virginia, but of establishing winter oat cultivation in such districts as Missouri and Kansas. In the durum wheat work special effort will be made to produce hardy winter sorts for use in the Great Plains area south of Nebraska. A continuation will be made also of the work of producing pure types of this wheat. A special study of the feeding value of a number of introduced barleys will be made, and studies will be continued to determine the cause of the deterioration of wheat. Under rust and smut investigations, particular attention will be given to the life history of the loose smut and to a study of the host plants of the grain rusts and the physiological relation of the rust to the host plant. In the rice investigations special attention will be given to the effects of different fertilizers, the amount of water to be employed in irrigation, and to methods of cultivation. In the study of grain sorghums an effort will be made to shorten the growing season of Kafir corn, in order that it may be able to mature on the high plains, and attention will be given to the development of better yielding and more drought-resistant varieties of milo. On the experimental farm at Amarillo, Tex., the adaptation tests of cereals will be continued and particular attention will be given to dates of seeding, rates of seeding per acre, and the manner of preparing the soil.

#### ARLINGTON EXPERIMENTAL FARM.

The work of the Arlington Experimental Farm during the past fiscal year has continued under the immediate direction of Prof. L. C. Corbett, horticulturist. Practically all of the field investigations conducted by the Bureau of Plant Industry in the vicinity of

Washington, D. C., as well as those of several other Bureaus of the Department of Agriculture, are carried on upon the area comprising the farm. Thus it will be seen that the farm is each year more completely fulfilling its original object, namely, to provide a field laboratory for the Department of Agriculture.

**GENERAL IMPROVEMENTS.**—It is the aim in the development of the Arlington Experimental Farm to add some permanent improvement each season. During the fiscal year just closed a steel water tower 50 feet in height, supporting a cypress tank of 500 barrels capacity, has been erected for the main water supply for greenhouse, irrigation, and stock requirements. A portion of the 4-inch main to distribute the water from this tank to the buildings has been installed. In addition to this improvement, two greenhouses of the same dimensions as those already erected upon the farm have been constructed. These two houses are each 20 feet wide and 100 feet long, each house being divided into two rooms, and especially piped for experimental use. Another permanent feature which has been added to the place and is a great convenience is a gravel drive constructed from the main entrance to and about the buildings. This drive has been added in conformity with the general scheme of walks and roads to be laid out on the farm, and has already proved of very great advantage during the rainy months of the year. Other permanent improvements are tile drains, which have been laid upon the main experimental plats of the farm, in the garden used for testing purposes, the grass garden, and in the 1-acre kitchen garden, 33,280 feet of tile drain being installed during the year.

One additional team has been purchased for the farm during the year. An implement worthy of special mention which has been added is a double-action disk harrow, which has proved to be one of the best soil-stirring implements that have been tested. The facilities of the carpenter shop at the farm have been increased by the installation of a saw bench with cut-off and rip-saw attachments.

**SOIL IMPROVEMENT.**—Up to the present time one of the main lines of endeavor has been to improve not only the mechanical and physical condition of the soil at the farm, but also to increase its fertility. This is being carried on in the simplest and most economical way possible, namely, by the use of cowpeas and of fertilizers in the form of phosphoric acid. It is aimed to counteract the effect of any acidity which may develop from the decomposition of cowpeas by the use of lime. This process of green manuring has proved very advantageous and has worked very remarkable changes in the character and productivity of the soil.

**MISCELLANEOUS EXPERIMENTS UNDER WAY.**—At the present time the Forest Service of the Department of Agriculture has an area at the farm devoted to the production of osier willows, while another small area is conducted as a nursery for evergreens. The Bureau of Entomology has established upon the farm an orchard and nursery for the propagation of fruit-bearing trees and plants, for the purpose of studying the methods of attack and the life history of various economic insects. It also maintains upon the farm areas devoted to growing mulberries to supply the necessary food for silkworms: a nursery devoted to the production of seedling mulberry plants and



cuttings for distribution as a foundation for the silk industry; and an orchard designed for the study of the physiological effect of various sprays used for insects upon the growth and development of the trees. The Bureau of Soils now has an area at the farm set aside for the study of soil problems in connection with its basket work in the greenhouse.

Among the numerous experiments conducted by the various offices of the Bureau of Plant Industry upon the farm are areas devoted to corn breeding, to the study of fiber plants and drug and medicinal plants, and to the cultivation of certain groups of economic importance for the purpose of studying their taxonomic relations. The Office of Seed and Plant Introduction and Distribution maintains at the farm a testing garden for the purpose of verifying the stock of seed used in the Congressional distribution; an area set apart for the testing and determination of grasses, which is known as the grass garden; and another area which is devoted to the cultivation of forage crops. The horticultural work at the farm is represented by a nursery of some 6 acres, in which is brought together a large variety of economic plants, including both fruit-bearing and decorative species. During the past year this collection has been increased by the addition of a number of varieties of peonies, irises, and other hardy herbaceous plants. The nursery now contains 2,423 economic fruit trees, 5,416 stocks of various kinds, 12,522 ornamental trees, exclusive of 30,000 mulberry seedlings and 25,000 1-year-old mulberry trees being used in the silk-culture work of the Bureau of Entomology, and 2,144 ornamental shrubs of various species, in addition to which there are 9,000 1-year-old privet cuttings and 13,300 privet plants between the ages of 1 and 3 years.

Additional features of the work of the Bureau of Plant Industry at the farm are a model 1-acre kitchen garden and a model 1-acre fruit garden. The permanent plantations in the way of orchards have been increased by several varieties of peaches and by planting the remaining nursery trees of the varieties of apples which have been grown upon the farm, making a total at the present time of about 400 varieties of apples and 250 varieties of peaches. Investigations are under way with a view of determining the principles underlying the heating, management, and ventilation of greenhouses in which flowers and vegetables are forced. The general problem of greenhouse physics is being studied in the glass area at the farm. The services of a trained man have been secured for conducting this work.

**VEGETABLE GROWING.**—The areas devoted to the 1-acre kitchen garden and that used for the testing of seed for the Office of Seed and Plant Introduction and Distribution have been greatly improved by drainage and by the addition of heavy dressings of stable manure. These areas, which have received the most intensive treatment of any upon the place, may be used to indicate the results which are possible upon the whole farm area.

**IRISH POTATO TESTS.**—Some four years ago about 70 varieties of white or Irish potatoes were brought together and grown upon the farm for three consecutive seasons, after which they were divided into sets which were distributed to the experiment stations in the representative potato-growing sections of the United States, namely, those of Vermont, Wisconsin, Texas, North Carolina, and West Vir-

ginia. After a three years' test seed from each testing station will be returned to the farm and grown side by side for the purpose of determining any changes which may have taken place as a result of the cultivation of the varieties under varying climatic conditions. In addition to the set distributed to each of the five stations named, a set is also maintained at the farm, and to this has been added about 130 varieties of recent introduction from abroad and from American sources. In this work on Irish potatoes the idea is to determine the types and varieties suited to different localities, the freedom of various sorts from disease, and also to ascertain which localities produce potatoes with excellent baking and boiling qualities.

WORK ON SWEET POTATOES.—Besides the test of Irish potatoes, a test of sweet potatoes is in progress at the farm and has this year been augmented by the addition of a number of new sorts. In addition to growing a collection of varieties, tests are being made to determine the yield and keeping quality of various sorts, the loss in storage, and the physical and chemical changes which take place in the potato during the storing period, as well as the physical conditions which exist in the storage house at the time the sweet potatoes are being stored and while they are in storage.

GROWING OF PLANTS UNDER SHADE.—Owing to the excessive humidity of the past season the shade work has not been altogether satisfactory. Under normal climatic conditions the atmosphere over the area at the farm inclosed by shade cloth usually carries a somewhat higher temperature and greater humidity than the surrounding air. During seasons of excessive rainfall these conditions become injurious rather than beneficial to most crops. While lettuce and gladiolus were a marked success during the past year under shade, the similar work on carnations was not as satisfactory as during the previous season.

MISCELLANEOUS FIELD INVESTIGATIONS.—In addition to the general development and maintenance of the Arlington Experimental Farm there are under way at the present time investigations of the peanut industry, for the purpose of improving and extending peanut culture from the standpoints of both the production of high-grade nuts for human consumption and the extension of the crop as a forage crop. A special study is being made of the cabbage and bean industry with the view of preparing for publication popular bulletins on these subjects in the near future.

Investigations of the diversification of crops on the rice lands of the Atlantic coast have been conducted during the year. Two testing gardens have been maintained upon the rice lands in the vicinity of Charleston, S. C., one located on the Cooper River and the other at Tea, S. C., on a somewhat different type of land from the former. At both of these stations very gratifying results have been obtained with both forage crops and vegetable crops, the onion crop at the Cooper River station being especially successful. The work has developed sufficiently to indicate with a very considerable degree of certainty the crops which may be used from this time on for demonstration purposes. The experiments have proved that any crop adapted to cultivation in this region can be grown on the rice lands, provided proper drainage is maintained.

**BERMUDA ONION INDUSTRY.**—The work which has been conducted throughout the States of Texas and Louisiana in cooperation with the Office of Farm Management Investigations has been directed chiefly to the oversight of trucking problems in Louisiana and several truck farms in Texas, in the latter State the main feature of the work being a study of the Bermuda onion industry of southern Texas. Information has been gathered in regard to the methods practiced in the cultivation of this crop in the area where it is grown, and steps have been taken to develop, if possible, a coordinate industry in the production of Bermuda onion seed. To this end a number of especially select bulbs have been secured for testing in various localities in order to determine the feasibility of producing Bermuda onion seed in this country. There is an urgent necessity for investigations looking toward the development of some region in which seed of Bermuda onions can be successfully grown in order to meet the demand of the territory now devoted to the cultivation of this crop in southwest Texas. It is hoped that funds will be available for the establishment of testing grounds in this region which will allow experiments to be conducted looking to the solution of this problem. Work along this line should be continued until it is determined whether or not satisfactory Bermuda onion seed can be grown in any portion of the United States.

**TRUCK CROP SURVEY.**—In the truck crop survey, which has been a side issue to all field work, no systematic work has been attempted, but each field investigator assigned for duty in any particular locality makes careful phenological notes for the region in which he is working and observes the dates of planting and harvesting of various economic crops in the region, with the view of accumulating data which at some future time may be used in connection with a more complete and comprehensive survey of the trucking districts of the United States. Such a line of work is greatly needed in order to place the trucking industry of the country upon a satisfactory basis; that is, so that there will not be an overplanting in any one locality and an underplanting in another, and also to establish phenological records upon which crop planting can be based, so as to provide a succession of crops in the different crop zones from the South to the North throughout the trucking areas of the United States.

The truck crop survey is each year becoming more and more important, as is illustrated by the commercial conditions prevailing in the potato market during the spring of 1905. The late crop of potatoes which was held over at the North practically made it impossible for the growers of early potatoes in the South to market their product at a profit. Had there been in existence a fully developed crop survey it would have been possible to avert, to a considerable extent at least, this condition, as it would have been possible to warn the planters against the extensive planting of early potatoes and thus avoid a great loss. Until such communication can be established between different sections the trucking industry will ever be a hazardous one.

**NOTE BLANKS.**—The note blanks which have been placed at the disposal of those who are conducting experiments and trials with vegetables have been reduced to a uniform system and have been provided



for several additional sorts, so that at the present time a nearly complete set of blanks is available for variety testing and for experimental work on vegetables. It is too soon to predict with certainty the ultimate good to come from this unification of variety testing, but there will be brought together a mass of material which will be of great service in determining the adaptation of varieties to different localities, as well as the permanence of horticultural varieties.

**RECOMMENDATIONS.**—While it is not the purpose to extend or increase the work at the Arlington Experimental Farm by the addition of new lines of investigation, yet the annual growth of the permanent plantations adds materially to the cost of general maintenance. The development of the farm has already outgrown the funds allotted for its maintenance, and steps must be taken either to curtail the demands made upon it for cooperative and demonstration work or to secure an increase in available funds. The urgent need for field investigations and demonstrations is sufficient to warrant the request for an increased appropriation rather than to attempt to reduce the usefulness of the farm. It is recommended, therefore, that an increase of at least \$5,000 be secured for the current expenses of the farm. The number of scientific workers who have interests centered about the farm render it necessary that laboratory facilities be provided for their needs in order that their work may be carried on in the most economical and satisfactory way. The recommendation made last year in regard to the necessities for a laboratory building which shall contain equipment for conducting investigations in the cold storage of fruits and vegetables is therefore urgently repeated. The large number of varieties of fruits which will soon be available at the farm renders this feature a very important one.

#### SUGAR BEET INVESTIGATIONS.

The work on sugar beets has continued during the past fiscal year, as in preceding years, under the charge of Dr. C. O. Townsend, pathologist, who reports as follows upon the progress of the investigations:

**DISEASES OF THE SUGAR BEET.**—The two diseases mentioned in the last report, namely, curly-top and leaf-spot, have been fully as destructive during the past season as in any of the preceding years since sugar beet growing has become a distinct industry. As heretofore, the curly-top disease has been confined to the sugar beet areas of the West, while the leaf-spot has been destructive only in the middle and eastern portions of the United States.

More than twenty theories have been investigated with a view to determining the cause of the curly-top disease, but thus far only negative results have been obtained. A detailed report of the field and greenhouse observations and experiments regarding this disease is in preparation. Experiments are still under way for the purpose of determining the cause of the disease and also with the hope of finding some practical means for its control.

A study of the life history of the fungus *Cercospora beticola*, the direct cause of the leaf-spot disease, is still in progress, together with field experiments for the purpose of determining the most effective

and at the same time most practical method of controlling the pest. It has been found that Bordeaux mixture properly applied will control the disease, but that the spraying need not be begun until the first spots appear on the leaves, which is usually in June, the first part of July, or even later, depending upon the age of the plant and upon weather conditions.

A number of other diseases affecting either the leaves or the roots of beets are under investigation, but up to the present time these diseases have been confined to limited areas.

**SINGLE-GERM BEET SEED.**—Inasmuch as two growing seasons are required for the production of beet seed, it has been considered advisable to conduct these experiments in duplicate, especially as the danger of losing more or less of the seed beets in the silo is considerable. For this reason the work done last year toward the production of single-germ beet seed was in part a repetition of the work of the preceding year. The percentage of single-germ seeds produced by selected plants grown from single-germ seed was a little higher in 1905 than in 1904. For example, the highest percentage of single-germ seeds produced by one of the selected plants in 1905 was 26, while in 1904 the highest percentage of singles produced by any one selected plant was 25. In addition to the seed produced last year, a large number of beets were grown from the single-germ seed obtained in 1904. These beets made a good growth, and the samples tested showed a sugar content of from 16 to 17 per cent. The purity coefficient was also found to be satisfactory. These beets were carefully labeled and put into silos located in two places. Unfortunately a large number of the beets in one of the silos decayed during the winter, and a larger percentage than usual of the seed beets that were planted failed to produce seed stalks. Neither of these conditions, however, was characteristic of the single-germ beets, since the same conditions obtained in connection with beets grown from multiple-germ seed both for experimental and for commercial purposes. The results obtained from the single-germ beets that are producing seed this year will not be known until the close of the season, but the indications are that some progress has been made as compared with the preceding generation.

**FERTILIZERS FOR SUGAR BEETS.**—Experiments were conducted again last season for the purpose of determining the relative values of green crops, stable manure, and commercial fertilizers used in connection with sugar beets. On the whole, the best results have been obtained with these fertilizers in the order named. Efforts are also being made to determine more closely the effect of the various ingredients of commercial fertilizer upon sugar beets. In general it has been found that phosphoric acid has a tendency to ripen beets prematurely, while nitrates delay the ripening period. Both classes of fertilizer experiments—that is, experiments which deal with complete fertilizers and with fertilizer ingredients—are in progress again this year, and it is expected to continue along these lines until more definite information is obtained regarding the influence of fertilizers and fertilizer ingredients upon sugar beets under the various soil and climatic conditions where sugar beets are grown.

**SELECTIONS OF BEETS.**—The work of selecting beets for the purpose of increasing the yield, improving the quality of the beets, developing an early maturing variety, and obtaining a variety resistant to alkali is still in progress. The latter project is carried on in cooperation with Mr. T. H. Kearney, physiologist, of Plant Breeding Investigations. While there are some difficulties to be overcome in each of these projects, the indications are that they will be successful eventually, although it will require several generations of plants to reach definite results. Selections are also being made with a view to obtaining beets that will grow successfully with less than the normal amount of water. Some seeds will be produced this year and more beets are being grown for seed production next year. Plans have been made for increasing and extending this important line of work.

**CULTURAL METHODS FOR SUGAR BEETS.**—Considerable doubt exists in the minds of many beet growers in regard to the best cultural methods to pursue in order to obtain the most satisfactory results. The experiments that have been undertaken this season promise some interesting data, but it will be necessary to continue these investigations for several seasons in order to determine the relation of the different cultural methods to the various soil and climatic conditions. The principal points under investigation are time and method of preparing the seed bed, width of row, subsoiling, time of plowing, and time and method of cultivating.

**SILONG SEED BEETS.**—For several years the question of keeping seed beets over the winter has been a troublesome one in some localities where seed production has been otherwise successful. Efforts have been made to determine the best method for keeping beets successfully. Two years ago several methods were tried with the result that the outdoor silo proved distinctly superior to the shed method. Last year many of the beets siloed in the open in some localities decayed, and of those that remained a large part, although apparently sound, failed to produce seed or even to develop any seed stalks. Experiments will be continued the coming season to determine what relation, if any, exists between the method of siloing and seed production and also to determine what modifications should be made in the methods of siloing to insure keeping the beets during the winter.

**EXTENSION OF SUGAR BEET AREA.**—Numerous requests are received every year for sugar beet seed for trial. These requests usually come from sections of the country where sugar beets have not been previously grown. As soon as possible after these requests are received the soil and climatic conditions in each case are determined and if they appear to be favorable to the culture of sugar beets a small quantity of seed is furnished, together with instructions for planting and for the subsequent care of the beets. In practically all cases trials are made by several farmers in the same locality and these trials are repeated two or more years in succession. In this manner the sugar beet area is being enlarged and new sections are being opened up for the development of this important industry.



## WESTERN AGRICULTURAL EXTENSION.

During the past year the work of Western Agricultural Extension, which was organized during the preceding year with Mr. Carl S. Scofield as agriculturist in charge, has been devoted chiefly to a reconnaissance of the agriculture of the Western United States, with special reference to the agricultural conditions of the localities soon to be put under irrigation by the Reclamation Service of the Department of the Interior.

**EXPERIMENTS UNDER WAY.**—At the request of the Reclamation Service, arrangements have been made for commencing some experimental work in testing crops on three of the reclamation projects, and cooperative work has already been started with farmers on two of the projects.

In addition to this work, an experimental farm is being conducted near San Antonio, Tex. The object of the work at this farm is to test new crops likely to prove of value to the region represented, and to find the best methods of tillage by which the relatively large but irregular rainfall of the region may be utilized in the profitable production of the staple crops.

**PLANS FOR FUTURE WORK.**—During the coming year it is proposed to continue the agricultural reconnaissance, with special emphasis on dry land agriculture in the intermountain area of the West, and to carry on the experimental work begun on the reclamation projects. On two of the projects—at Yuma, Ariz., and Fallon, Nev.—experimental work will be started on land set aside for this purpose by the Reclamation Service. The aim of this work will be to learn what crops can best be grown on these projects and how they should be handled, both as to tillage methods and as to rotations.

## DRY LAND AGRICULTURE.

The investigations of dry land agriculture in the Great Plains region of the West have been organized during the past fiscal year, with Mr. E. C. Chilcott as agriculturist in charge. During the development of the work of introducing drought-resistant cereals into the semiarid districts of the West, under the supervision of Mr. M. A. Carleton, cerealist in charge of Grain Investigations, it became apparent that investigations in cultivation methods and crop rotations should be carried on in connection with this work. The first step toward the accomplishment of this purpose was the appointment of Mr. Chilcott, then professor of geology and agronomy and agriculturist of the experiment station at the South Dakota Agricultural College, as expert in cultivation methods in connection with the work of Grain Investigations. As the work developed and assumed increasing importance, it was deemed desirable to make it independent of the Grain Investigations, and Mr. Chilcott has accordingly been placed in immediate charge of the investigations in dry land agriculture and the correlation of all cooperative work of the Bureau of Plant Industry in the Great Plains area of the West.

**OUTLINE OF THE WORK.**—The next step was to determine the area in which these investigations were to be carried on. After careful consideration it was decided to outline what is to be known as the

Great Plains area, by bounding it on the east by the ninety-eighth and on the west by the one hundred and fourth meridian of longitude and on the south by the thirty-second and on the north by the forty-ninth parallel of latitude. This area includes practically all of the semiarid district lying east of the Rocky Mountains, and covers about 330,000 square miles of territory where the problems of soil preparation and crop rotation are practically uniform.

Throughout this vast area there is not a single State experiment station, although there are substations at Dickinson and Edgely, N. Dak., Highmore, S. Dak., North Platte, Nebr., and Hays, Kans. Preliminary negotiations have already been entered into looking toward cooperative work between the Bureau of Plant Industry and the State substations at all these points, and it is also proposed that cooperative substations be established at other points in North Dakota, South Dakota, Nebraska, Colorado, and Oklahoma, at Garden City, Kans., and at Amarillo and Channing, Tex. It is the earnest desire of the Department to make these experiments truly cooperative, both in planning and in execution, and to bring together the best ideas and practices and work them out into a system of cooperation that will be of great benefit not only to the Department but to each of the cooperating stations, and ultimately to the farmers of this entire area. The actual practical experience of the men who have been in close touch with these problems in the field will be the basis of the work.

The field work has been well established at Edgeley, N. Dak., Highmore, S. Dak., North Platte, Nebr., Hays, Kans., and Amarillo, Tex. At Dickinson, N. Dak., and Bellefourche, S. Dak., it was found necessary to break up virgin prairies, and although this was done no other field work can be done at these points until the beginning of next season. Arrangements have, however, been made to develop it as soon as possible next spring.

**EXPERIMENTS IN SOIL PREPARATION.**—The purpose of this series of experiments is to ascertain as far as possible what system of cultivation will best conserve the soil moisture for the uses of the growing crop. There are many problems connected with the growing of crops in the semiarid districts that are of great importance and should be solved if possible without unnecessary delay, but experience has shown that better results are obtained when experiments are so planned as to involve as few variable factors as possible, and when all effort is centered upon a few general principles rather than upon many subsidiary problems. It is for this reason that these experiments have been made as simple and elementary as possible. The one question they are planned to answer is, How can the largest average yield of the four staple crops—corn, wheat, oats, and barley—through a long series of years be obtained? By raising the same crop continuously by the ordinary methods of culture now in practice; by continuous cropping with the same crop, using the most approved methods of cultivation for moisture conservation, or by alternate cropping and summer-fallowing by the most approved methods? It will be the aim to determine which of the answers suggested is the correct one.

**CROP ROTATIONS.**—There are few, if any, problems in farm management of greater importance than that of crop rotation. The importance of the problem has been recognized in the older portions of

this country for many years, but it is only very recently that it has been given any attention in the West. It has even been claimed that it is not of as great importance in the West as in the East. Far from such being the case, it is probably of even greater importance where the subject of moisture conservation is an essential one than in the more humid districts. Very little carefully planned and systematically executed experimental work in crop rotation has been carried on in this country.

In order to reduce the number of variable factors as much as possible, it has been considered desirable to confine these experiments to rotations of a uniform length, and after careful study a three-year rotation has been decided upon as the best for the purpose of this experiment, although probably not the best for general farm practice. In the selection of crops it has been deemed advisable to confine the work to the four staple crops grown in this district, namely; corn, wheat, oats, and barley, for these are the only crops that are grown extensively throughout the entire district extending from the Panhandle of Texas on the south to the Canadian boundary on the north.

**HUMUS CONSERVATION.**—Nearly all of the various systems of farming heretofore practiced in the semiarid districts have had for their prime object the conservation of soil moisture, but the conservation of the humus, or organic matter of the soil, has been entirely neglected. In fact, some of the most popular methods of moisture conservation are the most destructive of organic matter. While these methods may serve to increase the yields temporarily through moisture conservation, their efficacy will decrease with the decreasing organic matter in the soil until ultimately they may become practically inoperative.

In order to make a thorough study of the relations between the organic matter of the soil and the conservation of soil moisture a number of rotations will be inaugurated at each of the substations. These rotations will include not only the above-mentioned four staple crops, common to the entire area, but will also include crops peculiar to the several localities, and both annuals and perennials of the leguminous and nonleguminous types adapted to green manuring, or, in other words, to the conservation of the organic matter in the soil.

### **HORTICULTURAL INVESTIGATIONS.**

The pomological work of the Bureau and the work of Experimental Gardens and Grounds have been grouped under the heading of Horticultural Investigations. The former line of work has been partially reorganized, the pomological field investigations being placed under the immediate charge of Messrs. William A. Taylor and G. Harold Powell, pomologists, while the work conducted entirely in the city of Washington will continue under the charge of Col. G. B. Brackett, pomologist, as heretofore. The reports of the officers in charge of these lines of work follow.

### **POMOLOGICAL COLLECTIONS.**

The work of Pomological Collections, under the supervision of Col. G. B. Brackett, pomologist, has continued during the past fiscal



year along the same general lines as heretofore. Following are the subjects receiving principal attention:

**DISSEMINATION OF INFORMATION.**—Fruit culture is now recognized as one of the leading commercial industries of the country, and the increase in the acreage planted amounts to thousands of acres annually. This office is engaged in investigating, collecting, and disseminating information relating to the fruit industry; cooperating through correspondence in the extension of orchard areas and the renovation of old orchards, the selection of orchard sites and of varieties with a view to soil and climatic adaptability; and dealing with the various problems that confront local and commercial orchardists.

**SIMPLIFICATION OF FRUIT NOMENCLATURE.**—The lack of simplicity and uniformity in nomenclature of American fruits has been in the past a source of great losses, and until a certain name in one nurseryman's catalogue stands for the same variety that this particular name represents in another nurseryman's catalogue planters will necessarily suffer additional losses. This office is cooperating with the American Pomological Society in the purification of fruit nomenclature, Bulletin No. 56 of the Bureau of Plant Industry, "Nomenclature of the Apple," embodying the first published results of this work, having met with a very favorable reception. A publication on the nomenclature of the pear is now in preparation, and it is hoped that it will be completed during the year.

**IDENTIFICATION AND ESTIMATION OF FRUITS.**—During the year 1,596 fruits were submitted for examination by orchardists and fruit growers. Of this number, 510 varieties were sent for identification, 233 of which were unrecognized. There were 388 paintings of fruits made, and 389 descriptions of specimens for the purpose of placing the varieties on record in the office were prepared. There were 377 varieties of new fruits received during the year, some of which were seedlings. They were carefully examined and their relative merits reported upon, many of the new varieties being promising. During the year this office sent 177 varieties of fruits to State experiment stations and other places throughout the country for the purpose of testing their adaptability to location.

In connection with the identification of fruits a pomological herbarium is maintained. It is quite as necessary to examine and classify the foliage as the fruits, and the identification of the latter often depends upon an examination of the former. During the year 766 specimens were added to the herbarium collection.

**COOPERATIVE VARIETY ORCHARD.**—The Arlington Experimental Farm maintains in cooperation with this office an experimental orchard, the object of which is to include all of the deciduous fruits, both wild and cultivated, for the study of their characteristics with reference to quality and relative value for commercial and family use, for the determination of cultural adaptability and the correcting of nomenclature, for establishing the identity of varieties, and for the dissemination of scions of well-authenticated sorts. A very creditable beginning has been made in this work, and it is confidently expected that the results will be very satisfactory.

## FIELD INVESTIGATIONS IN POMOLOGY.

The pomological field investigations have been prosecuted during the past year under the immediate direction of Messrs. William A. Taylor and G. Harold Powell, pomologists in charge. The lines of work outlined in the last report have been followed, with such modifications as to fruits experimented upon and regions worked in as the crop conditions and other variable factors have made necessary. The study of problems concerning the long-distance transportation of fresh fruits has been given increased attention, owing to their vital commercial importance and the widespread desire among growers, shippers, transportation companies, and warehousemen for more exact knowledge regarding the underlying principles that govern the maintenance in sound condition of fresh fruit while in transit or in storage.

## FRUIT MARKETING.

The investigations of fruit marketing have continued to be personally conducted by Mr. William A. Taylor, associated with Mr. G. Harold Powell. Experimental studies of the methods of harvesting, packing, and forwarding summer apples, peaches, and winter apples, chiefly to European markets, have been made during the year. In these investigations an effort is made to ascertain the relation of varieties, packages, methods of packing, etc., to the requirements of long-distance shipment, with special reference to conditions experienced in ocean transit.

**SUMMER APPLES.**—The experimental export shipments of summer apples from Delaware have demonstrated the practicability of delivering even the tender early sorts in the markets of the United Kingdom in sound and wholesome condition when proper care is observed in handling and packing the fruit and the necessary facilities for quick transfer of the fruit from the tree to the refrigerated compartment are available. Whether the extra care required in handling such shipments will be properly compensated by higher net proceeds of such shipments over similar fruits in American markets depends largely upon the relative abundance of competing fruits in foreign and domestic markets at the time of sale.

**WINTER APPLES.**—In the fruit marketing work great attention is still being paid to problems involved in the handling of winter apples for export. The apple is recognized as being at the same time our most valuable fruit crop and the one affecting the largest number of producers and consumers. The apple crop of 1905 was, according to commercial estimates, the smallest of the past decade, being little more than half as large as that of the preceding year. Notwithstanding this, the exports were but 20 per cent less in quantity than during the preceding year and but 7 per cent less than the average of the preceding five years. Notwithstanding the high prices that prevailed in our domestic markets during the autumn and winter, for the first time since comprehensive commercial estimates of the apple crop have been formulated the exports of this fruit exceeded 5 per cent of the estimated total crop. As the average percentage of the crop exported during the previous five years was slightly less than 3 per cent and during the preceding decade but 2 per cent, the

strength of the European demand for this fruit was very effectively demonstrated. As has been previously suggested, the fostering and establishing of this export trade until it reaches a sound economic basis is a matter of the most profound importance to the American apple industry. More complete information as to conditions prevailing on the ocean and in foreign markets is greatly needed.

**PEACHES.**—The adverse climatic and crop conditions in the Eastern States during the greater part of the summer of 1905 rendered extensive experimental export shipments of peaches inadvisable with the facilities available. A successful shipment of the Bilyeu variety from Virginia in September, 1905, again demonstrated the entire practicability of trans-Atlantic shipment of the later varieties from the orchard regions from Virginia and West Virginia northward, wherever properly adjusted railroad schedules are available and the necessary ocean refrigeration obtainable.

**PEARS.**—The export trade in Bartlett and other early pears from New York, inaugurated by the Department's experiments in 1901, shows a gratifying growth, the total exports of pears during the past year being valued at \$631,972. Just what portion of this sum represents the value of the early varieties in distinction from the Kieffer and other late sorts can not be determined with exactness, but in view of the very light exports of California pears for the season it appears probable that the early eastern fruit made up at least \$500,000 of the total amount mentioned. Although none of these exports are known to have originated west of Buffalo, N. Y., the beneficial effect of the movement across the Atlantic of so large a proportion of the eastern crop was conspicuously evident in central and western markets, which in many former years have been overloaded with eastern fruit in addition to that from near-by producing districts.

#### FRUIT TRANSPORTATION AND STORAGE.

The investigations of the transportation and storage of fruits have been conducted during the past year, as heretofore, by Mr. G. Harold Powell, pomologist in charge, who has been assisted by Mr. A. V. Stubenrauch, special agent, and Mr. L. S. Tenny, assistant pomologist. The fruit transportation investigations have been confined to the deciduous and citrus fruits of the Pacific coast.

**PEACHES AND PLUMS.**—Continuing the experiments similar to those with Georgia peaches outlined in the last report, peaches and plums that had been allowed to reach hard ripeness on the trees were forwarded in ten cars from Newcastle, Cal., to eastern markets, the fruit having been cooled before shipping to about 50° F. to quickly check the ripening. It was intended to cool it to 40° F., but the lower temperature could not be obtained with the available cooling facilities.

The outcome of the shipments was encouraging in all directions. Practically all of the fruit arrived in New York in sound condition. There was slight ripening in transit, but much less than in the usual commercial methods of shipment. The fruit in the top of the car was slightly riper than that in the bottom, but the difference was less than in commercial lots shipped at the same time. The



fruit was more attractive and of better quality than the usual commercial lots on account of having ripened at least a week longer before picking. It is probable that a larger export trade in perishable fruits can be developed if practical methods can be devised for cooling the fruit before shipment, and that a wider distribution in domestic markets can be brought about on account of the better carrying quality.

This work has had the active cooperation of shippers and transportation companies in California. It has awakened the interest of refrigerating engineers, shippers, and transportation lines in devising practical methods of improving and handling this class of produce.

ORANGES.—Continuing the orange experiments mentioned in the report for 1905 large quantities of oranges handled in different ways have been under observation in California during the year. In addition, fruit was forwarded to New York in 70 cars under (1) ventilation, (2) ordinary icing, or (3) precooled to about 40° F., followed by ordinary icing. Our own representatives accompanied the cars from California to New York at different times to determine the temperature changes that occur in the fruit and in the air of the cars.

As a result of holding the orange under favorable conditions for decay in California, sound fruit as it comes from the tree seldom decayed. The rot increased as the handling became complex and severe. In about 50 experiments sound fruit from the tree developed 1.5 per cent decay, which was increased to 4.5 per cent by brushing and 10.5 per cent by washing. Where all of the oranges showed slight mechanical injuries, such as clipper cuts, stem punctures, finger-nail scratches, or other types of bruising, from 25 to 75 per cent decayed.

In the shipping experiments a similar difference in decay developed. There was practically no decay in sound fruit that had been handled very carefully under any of the methods of shipment, but as the handling was increased the losses multiplied. Washed oranges developed more rot than brushed or unbrushed fruit, and the fruit in which the mechanical injuries were visible developed the maximum amount.

Comparing the different methods of shipment, the fruit that was susceptible to rot, like the washed and the mechanically injured fruit, developed most decay under ventilation and least under precooling followed by ordinary icing. To illustrate the comparative efficiency, the rot in mechanically injured oranges was as follows: Ventilation, 14 per cent; icing, 7 per cent, and precooling followed by icing, 4 per cent.

To determine the effect of holding the orange different lengths of time after packing, fruit was forwarded in 20 cars under icing to New York. The results, as in all other experiments, indicate that a sound orange handled with great care is most resistant to adverse treatment, while oranges made susceptible by complex handling develop the most trouble in transit. The decay developed as the time increased between packing and shipping, but the increase was greatest in the washed and in the mechanically injured oranges. To illustrate, the average decay in carefully brushed fruit in all the shipments was 1 per cent, while it was 5 per cent in the washed and

12 per cent in the mechanically injured fruit. The average decay on all lots shipped the first day after packing was 2 per cent; the third day, 3.5 per cent; the fifth day, 8.6 per cent, and the seventh day after packing, 9.5 per cent.

These investigations have had the active support of growers, shippers, and transportation interests, all of which have given the Bureau hearty cooperation, and on account of the thorough organization of the industry it has been able to put into practice the results of the investigations. Mechanical injuries are being reduced; packing houses are being remodeled in the direction of simplicity; the fruit was shipped during the past season more quickly after picking than ever before; a campaign for better spraying and fumigation has been started to overcome the necessity for washing the fruit, and the transportation companies have shown a disposition to make their service conform to the facts developed by the experiments. It is estimated by prominent shipping interests that the work of the Bureau of Plant Industry was worth at least a quarter of a million dollars to the growers during the season of 1905-6.

**WORK ON FRUIT STORAGE.**—The fruit-storage investigations have been extended to the Pacific coast, and large quantities of apples from different sections of California were stored in Los Angeles, Cal., and in Jersey City, N. J., to determine the influence of different methods of handling and, in addition, of a transcontinental trip on the keeping of the fruit. The cooperative study of the effect of sod and tillage treatments on the keeping of apples has been continued with the New York Experiment Station, and a number of technical studies regarding warehouse temperatures have been under way in the East. Special attention has been given to the farm storage-house problem, the results of which will be submitted for publication in the near future.

#### VITICULTURAL INVESTIGATIONS.

The work on grapes has continued under the charge of Mr. George C. Husmann, pomologist. In the Pacific coast investigations the problems mentioned in former reports have received increased attention, and others have been taken up in connection with them. To encourage private investigation and broaden the scope of the work, cuttings of many promising varieties of grapes have been distributed to individuals requesting them. The call for information on the pruning, training, grafting, and culture of the grape and the best ways of handling, keeping, and marketing the fruit, as well as the manufacture, storing, and disposition of the products, is constantly increasing. Samples of fruit and products sent in have been examined, and descriptions and illustrations made of new and especially promising varieties.

**EXPERIMENTAL VINEYARDS.**—Additional resistant varieties have been planted in the experimental vineyards, and other *Vinifera* varieties were grafted on additional resistant stock varieties. New *Vinifera* introductions are being grafted and fruited to determine whether they have a specific value before distributing them.

The larger California experimental vineyards are three in number, being located at Oakville, Fresno, and Cucamonga, and cover each from 6 to 10½ acres. Each vineyard contains at present from 60 to

200 resistant and direct producers and from 180 to 280 *Vinifera* varieties grafted on resistant stock. Six smaller experimental vineyards of 1 or 2 acres, located on representative vineyard soils in the State, are each planted to from 70 to 100 varieties of resistants and direct producers.

At the Plant Introduction Garden at Chico, Cal., 120 varieties were planted in the varietal collection vineyard, and cuttings of 211 resistant varieties have been planted in the nursery to make a relative rooting test. At the Subtropical Laboratory at Miami, Fla., a small collection of vines has been maintained with a view to developing a special method of training adapted to Florida conditions.

RESULTS SECURED.—Some of the work started in previous years is yielding interesting results. For instance, of 20 *Vinifera* wine varieties, grafted in regular checks on different stocks at the Oakville vineyard, an average stand of 96 per cent on Champini, 89.5 per cent on Doaniana, 74.6 per cent on Herbemont, 72.5 on Lenoir, 51.7 on Rupestris Martin, and 49.5 per cent on Rupestris St. George was obtained. At the Fresno vineyard, of 10 *Vinifera* varieties grafted, an average of 90 per cent on Champini, 80 per cent on Lenoir, 80 per cent on Doaniana, 72 per cent on Riparia Gloire de Montpellier, 71 per cent on Herbemont, 63 per cent on Rupestris St. George, and 58 per cent on Rupestris Martin was obtained.

Some of the resistant varieties appear to adjust themselves remarkably well to different soils, while some do exceedingly well on certain soils, but fail entirely on others. Rainfall records are being kept at all the vineyards, and temperature records at Cucamonga, Fresno, and Oakville. The names have been conspicuously placed on the varieties, so that comparative studies can be made by the many growers visiting them.

ROTUNDIFOLIA GRAPES.—In the investigation of the *Rotundifolia* type, a systematic field survey of the species as found both in the forests and under cultivation has been begun. About thirty distinct cultural varieties of more or less merit have been located, and their origin, history, and vineyard record investigated. Herbarium specimens, photographs, and descriptions of most of these varieties have been secured and arrangements made for the propagation of specimen vines for varietal testing. The present methods of culture, training, and pruning, relative suitability of soils, marketability and domestic use of the fruit, and probable cost of production and yield per acre have been studied. The marked differences found in the size, color, flavor, texture, and quality of the varieties in cultivation, most of which are mere wild vines or accidental seedlings, indicate great possibilities of improvement under systematic effort, and bid fair to bring into profitable culture considerable areas of unused land in the South Atlantic and Gulf States.

#### FRUIT DISTRICT INVESTIGATIONS.

The fruit district investigations have continued in charge of Mr. H. P. Gould, assistant pomologist. The work has progressed along the same general lines as indicated in previous reports. Some attention has also been given to certain incidental problems. All the



work has been directed toward one main object, viz, the determination of the adaptability of fruit varieties to different conditions and their value for specific purposes as influenced by the conditions under which they are grown. It has been prosecuted in several sections of the country and has included phenological studies; varietal adaptability investigations of orchard fruits in the Piedmont and Blue Ridge areas of the Southern States, in the Shenandoah and Cumberland valleys, comprising the Great Appalachian Valley, and in the Ozark region of Missouri and Arkansas; and studies of early apple varieties and their adaptability to conditions in the coastal plain of the Middle and South Atlantic States. The more important incidental problems studied have been the evaporation of apples, the self-sterility of peaches, and cross and self-pollination studies of certain important commercial varieties of apples.

**MISCELLANEOUS PROBLEMS.**—The phenological studies have been continued on the same scope and basis as in previous years. The investigations in the Piedmont and Blue Ridge areas have reached a point where a preliminary report upon the adaptability of varieties of orchard fruits in these areas seems advisable. Such a report has been prepared and submitted with a view to publication. Field work in the Appalachian Valley was begun during the autumn of 1905, and must be continued for a considerable period of time before a detailed report is possible.

Investigations in the Ozark region of Missouri and Arkansas have been in progress during portions of three seasons. Extremely unfavorable climatic conditions have prevailed at some period during each of these years, seriously injuring the fruit crop, and in many instances making it a complete failure. Further investigations in this area would therefore seem to be essential.

**STUDIES OF APPLES.**—The field investigations of early apples on the Delaware Peninsula and in southern New Jersey were continued. The results of the three seasons' study covered by this work are being compiled with a view to their publication.

#### PLANS FOR FUTURE WORK.

The pomological field investigations will be continued during the ensuing fiscal year along the same general lines as outlined in the present report. They may be briefly summarized as follows:

**FRUIT MARKETING.**—The work in fruit marketing planned for the current year includes a continuation of the studies of grading and sizing eastern winter apples, investigations as to their availability and value for export, and further experimental investigation of questions involved in the exportation of early apples, peaches, pineapples, and pomelos. It is hoped that certain studies of important economic features of fruit handling, such as cooperative packing, can also be taken up in connection with other phases of the work.

**FRUIT TRANSPORTATION AND STORAGE.**—A continuation of the following lines of work is contemplated: The investigations of the influence of cultural methods on the keeping quality of fruit, both as an independent study and in cooperation with the New York State

Experiment Station, on certain phases of the work; of the principles which govern the successful handling of fruits on the Pacific coast for storage purposes; the adaptability of different systems of cold storage to fruit-farm conditions; the causes of losses in perishable fruits in transit; the causes of losses in citrus fruits from decay in California and an extension of the work to Florida; and the investigation of chemical changes in stored fruit, in cooperation with the Bureau of Chemistry. An extension of the fruit storage work to the central United States, in cooperation with the Iowa Agricultural Experiment Station, is also contemplated.

**VITICULTURAL INVESTIGATIONS.**—The various problems undertaken in the investigation of the *Rotundifolia* type of grape are to be continued. The establishment of a suitably located cooperative experimental vineyard in which to assemble for comparison, study, and test the promising varieties that are being located is contemplated. Experiments in propagation already begun will be continued, and some pollination studies will be undertaken.

The investigations in the California experimental vineyards will be enlarged. Systematic observations on the congeniality of scions to stocks, fruiting notes on both *Viniferas* and direct producers, data on adaptability of varieties to soil and climatic conditions and viticultural districts, and observations on the resistance of varieties and on the relative rooting qualities of resistant varieties will be made. Extensive nursery grafting experiments in connection with the relative rooting tests of stocks at the Plant Introduction Garden at Chico, Cal., are contemplated.

**FRUIT DISTRICT INVESTIGATIONS.**—In the fruit district work, as already indicated, many of the problems now under consideration require further attention. Plans for the immediate future, therefore, involve mainly a continued investigation of the projects now in hand. It is also hoped that a comprehensive study of the adaptability of peach varieties in the Southern and South Central States can be undertaken during the year.

#### **EXPERIMENTAL GARDEN AND GROUNDS.**

This branch of the Bureau has continued, as heretofore, under the supervision of Mr. E. M. Byrnes, superintendent. In connection with the regular work of the year there were propagated and distributed 92,306 plants, representing 67 different species and varieties. The following changes and improvements have taken place during the past fiscal year:

**GREENHOUSE REPAIRS.**—Such minor repairs were made to the old greenhouses as were necessary to keep them in a temporarily serviceable condition. Additional heating surface was placed in two of the houses, about 800 feet of pipe being used in the work. The hallway connecting the new range of greenhouses with the offices and work-rooms was painted, and the two steam boilers heating the old range of greenhouses and the office rooms of the Bureau were overhauled, cleaned, painted, covered with fire clay, and furnished with a new lining of fire brick and new grate bars. Additional machinery has been installed in the carpenter shop connected with the greenhouses.

A cold-storage room 7 by 9 feet was built for the Office of Seed and Plant Introduction and Distribution at the north end of the slat shed used for storing grapevines and strawberry plants in connection with the Congressional seed distribution. There has also been erected a slat shed 142 feet long, 20 feet wide, and 12 feet high for the purpose of storing compost material. A tool room 22 feet long has been constructed at the south end of this shed.

**GREENHOUSE OPERATIONS.**—In the new range of greenhouses Nos. 1 and 2 are devoted to the propagation of new plants and fruits collected by the Office of Seed and Plant Introduction and Distribution; No. 3 is devoted to seed testing, tea culture, and drug plant investigations, and a section is used as a quarantine house for plants received from abroad which are infested with fungous and insect pests; No. 4 is used for experimental work of various offices of the Bureau; No. 5 is devoted to the propagation of plants from cuttings sent in by the Office of Seed and Plant Introduction and Distribution which are used for ornamenting the grounds, for experimental work, and for distribution, and No. 6 contains a collection of tropical and sub-tropical plants.

House No. 7 is devoted to growing the stock of bedding plants during the winter and spring and to a collection of chrysanthemum plants during the summer and autumn. The collection of chrysanthemums this year is composed of 1,795 plants in 203 varieties and 140 seedlings. Of the varieties 57 were selected as the best of the collection grown last year; 146 are new, selected as the best of those distributed in 1906, while the 140 seedling plants are the result of crosses made last autumn. Our annual chrysanthemum show was open to the public from October 30 to November 7, 1905. It is estimated that 45,000 people visited the show during the eight days it was open. On the morning of November 8 four wagonloads of chrysanthemum blooms were cut and distributed to the various hospitals in Washington, D. C.

House No. 8 has been planted for experimental work with 1,286 rose plants in 8 varieties, while Nos. 9 and 10 are devoted to experimental work with vegetables.

Houses Nos. 11, 12, and 13 have been planted for experimental work with 3,459 carnation plants in nine of the leading commercial varieties and 1,087 seedling plants. These plants will be grown under glass throughout the season. Bench space has been reserved in these houses for 1,429 carnation plants of commercial varieties, field grown, which will be immediately planted. Of these, 342 will be planted in 114 boxes, 3 plants in each box, which will contain 1 cubic foot of soil. The total number of carnations planted in the house will be 5,975 in nine of the leading commercial varieties and 1,087 seedling plants. The latter are the result of crosses made last winter. Considerable work has been accomplished in the past season in breeding greenhouse carnations. Several seedlings show new departures from the parents in very long stems, well-developed calyxes, and freedom in blooming.

The croton has come into use during recent years for summer planting in parks, the richly colored foliage of this tropical shrub making it very desirable for this purpose. Several new forms which promise well have been produced in the greenhouse, being improve-



ments over already existing varieties. Other ornamental plants which have been taken up with a view to their improvement are the chrysanthemum, hippeastrum, poinsettia, and pelargonium. Among the seedling chrysanthemums raised last summer several distinct and desirable forms made their appearance.

In the old range of greenhouses No. 1 is devoted principally to a collection of economic plants; No. 2 has been used by Normal School No. 2, of Washington, D. C., in school garden work; No. 3 and a temporary sash house 90 feet long, 11 feet wide, and 10 feet high are devoted to the experimental work of various offices of the Bureau; No. 4 is assigned for school-garden work to Normal School No. 1, of Washington, D. C.; No. 5 is devoted to a collection of citrus and other tropical fruits; while No. 6 contains a collection of 81 varieties of European grapes.

**GENERAL IMPROVEMENTS.**—An open trench 1,620 feet long, on the east front of the grounds, which carried off surface water from heavy rains, was filled, graded, surfaced with topsoil, and sown down in grass. A cement walk 12 feet wide and 36 feet long was laid across the parking at the northwest corner of the grounds; 2,362 feet of 18-foot-wide gravel roads were resurfaced with 281 cubic yards of bank gravel; a cement gutter 520 feet long and 2 feet wide was laid on the south side of the gravel road in the northwest portion of the grounds; a brick catch-basin, with iron grate, was built and connected to the sewer with 225 feet of 6-inch terra-cotta pipe to drain this portion of the grounds during heavy rains; 80 square yards of asphalt road and walks were repaired, and a brick tank 5 feet deep, 10 feet wide, and 16 feet long was built underground near the new greenhouses and covered with lumber. This tank is used for liquid fertilizer, a hand force pump being mounted on the tank and the fertilizer pumped into the greenhouses as required.

The site occupied by the new range of greenhouses and the new trial grounds was inclosed on the south and east fronts with a neat galvanized-wire-mesh fence 800 feet long and 5 feet high, with 2-inch iron pipe posts and 1-inch rail for supports.

During the season the lawns were mowed and their edges trimmed as often as required to maintain them in good condition. The asphalt roads and walks were swept daily and the gravel roads were kept clean and free from weed growth; dead branches were removed from the trees and shrubs and the shrubs were pruned; and the privet, osage orange, and arbor vitae hedges were trimmed twice during the season. During the winter a portion of the lawns was top-dressed with 300 cubic yards of well decomposed stable manure. About 3 acres in the northeast corner of the grounds were manured, plowed, and fenced in with 900 linear feet of 4-foot heavy steel-wire fencing; a tool room was built and two closets installed on the ground, and the plot was allotted to the public schools of Washington, D. C., for school-garden work.

**ORNAMENTAL PLANTING IN THE GROUNDS.**—A collection of 10,500 standard sorts of hyacinth, tulip, and narcissus bulbs and 2,700 pansy plants was planted in the grounds in the autumn for display in the early spring; a collection of 16,267 bedding plants, in 57 species and varieties, and 530 tropical plants, in 30 species and varieties, were planted in beds; 358 hardy climbing plants and vines

were planted to cover the wire-mesh fence inclosing the new range of greenhouses and trial grounds, the north side and west end of the building used for offices and workrooms, and one slat storage shed; 230 rapid-growing annual flowering vines were planted to cover the frame buildings, sheds, and board fence south of the Department building; and 68 flowering shrubs, in 32 species and varieties, 24 pine trees, in 4 varieties, 7 young willow trees, each of a different variety, and 8 young oak trees, in 4 varieties, were planted in the grounds in cooperation with the Office of Seed and Plant Introduction and Distribution. There were also planted in our trial grounds 7,243 hybrid lettuce plants for seed selection and a new variety of the cowpea from India for testing.

#### SEED AND PLANT INTRODUCTION INVESTIGATIONS.

Under this general heading have been grouped the Office of Seed and Plant Introduction and Distribution and also the Seed Laboratory. The progress of these lines of work during the past fiscal year is reported in the following paragraphs:

#### SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

(This branch of the Bureau during the year was in charge of Mr. A. J. Pieters, botanist, and Mr. David Fairchild, agricultural explorer. Mr. Pieters resigned on September 20, 1906, to engage in private business.) The report of these officers on the work under their charge during the past year follows:

#### FOREIGN INTRODUCTIONS AND PROGRESS MADE THEREWITH.

The work of introducing promising seeds and plants from foreign countries for testing as to their adaptability to various sections of the United States has continued, as in preceding years, under the immediate direction of Mr. David Fairchild. A summarized statement of the work of the year, including the progress made with some of the importations of previous years, follows:

(AGRICULTURAL EXPLORATIONS OF THE YEAR.—The exploration work for the year has been practically confined to the Chinese Empire. In August, 1905, Mr. Frank N. Meyer was sent as agricultural explorer to Peking. It is known that a great many of our cultivated fruits had their origin somewhere in China, and many reports from missionaries, consuls, and travelers have shown that the Chinese Empire is still unusually well supplied with fruits unknown or, at least, little known to the people of the United States. It is also well known that the climatic conditions of Manchuria approximate very closely those of our northwestern plains region, and it is believed that the exploration of Manchuria will reveal the presence of many valuable cultivated and wild plants which will prove perfectly hardy on the plains of the Northwest where fruit and shade trees and hardy grains are greatly needed. Mr. Meyer was instructed to spend the winter in the neighborhood of Peking and a part of his time in the vicinity of Shanghai, with the intention of authorizing him to proceed into Manchuria in the spring. This plan was carried out, and Mr. Meyer

is now in Manchuria, having received permission from the Japanese Government to explore that country.

A great quantity of living material has already been received from Mr. Meyer, and by quick and careful propagation in the greenhouses at Washington and in the Plant Introduction Garden at Chico, Cal., this now represents hundreds of thousands of grafted trees or growing seedlings of greater or less promise for the farmers and fruit growers of the country. Among the three hundred or more lots of seeds and plants sent in are the seedless hardy North China persimmon, which can be grown in the Northern States, a hardy wild apricot for the breeders of this fruit, a new hardy peach, soft-shelled walnuts, interesting Chinese grape varieties, an edible-fruited hawthorn, interesting maples and pines for our parks, chestnuts and edible-kernelled apricots, and untried seeds of rices, sorghums, cabbages, spinach, and radish.

**DATE GARDENS.**—The introduction of new varieties of the date palm has been confined during the year to an importation from the Sahara of three suckers of "Tazeza'oot" and three of "Bent Kebala" dates, which were distributed among the gardens at Yuma and Tempe, Ariz., and Mecca, Cal., maintained in cooperation with Plant Life History Investigations. It has been the policy during the past year to continue the Mecca garden, but to incur no greater expense than necessary in doing so. The rise of water in the Salton Basin caused by the inflow from the Colorado River has been so great as to form a serious menace to the safety of this garden, and everything has been kept in readiness to move the date palms whenever it might become necessary. Up to the end of the last fiscal year such necessity had not arisen, although the garden at that time was only 30 feet above the surface of the new lake. It has been necessary to make a special effort during the year to destroy certain scales and other insect pests that have been found on the date palms, and in order to protect the future of this industry two competent men have been sent to every place where imported date palms have been planted recently and every infected or suspicious looking tree has been treated with hydrocyanic-acid gas.

**RESISTANT GRAPES.**—The investigations in the introduction of phylloxera-resistant varieties of grapes, carried on in cooperation with the Field Investigations in Pomology, have been continued during the past year, one new vineyard having been established in the neighborhood of Stockton, Cal., and a beginning having been made on a varietal plantation of resistant vines at the Plant Introduction Garden at Chico, Cal. The vineyards, especially the one at Oakville, Cal., have been kept in excellent order and will no doubt prove extremely useful. This work is more fully discussed in the report on viticultural investigations, Field Investigations in Pomology.

**YAUTIAS, TAROS, AND DASHEENS.**—These three remarkable wet-land root crops, whose importance was first emphasized by Mr. W. O. Barrett, of this Bureau, have been tried in the South and give promise of success. They promise so much, in fact, that from different parts of the world many varieties have been assembled for trial until the Department has the largest collection of these plants in the world. They are related to the common caladium of our flower beds and



grow best in land that is too wet for ordinary crops. Throughout the Southern States, as far north as the Carolinas, certain varieties will grow and produce their abundant edible roots. These are not only a pleasant change from the ordinary sweet and common potato, which they resemble in composition, but are such abundant starch producers that they may play a decided rôle as stock food or in alcohol production. The possibility of a new root crop for wet lands lies in these plants.

**JAPANESE MATTING RUSH.**—During the year work has been continued on the matting-rush garden near Georgetown, S. C. The location of the garden was changed from Cat Island to nearer Georgetown, owing to the fact that the soil in the latter place seems better adapted to this culture and the locality is more convenient of access. The results of two years' work seem to indicate that most of the rice lands of this part of the State are too heavy and too rich to grow the matting rush to perfection. The rush grows thickly, but not to a sufficient length. It is believed, however, that by the proper selection of plants and by growing them upon the more sandy areas of the rice lands, they will make a sufficient growth for use by matting manufacturers.

An important development of the year was the discovery that the common American rush, *Scirpus americanus*, could be used for the manufacture of a coarse grade of matting. Three experts have been sent into the field for a short period to determine where a large quantity of this plant can be found in native growth and to send samples of it to manufacturers for testing. The results so far obtained have been entirely satisfactory and show that under proper conditions it can be made useful in the manufacture of matting.

**MISCELLANEOUS TROPICAL AND SUBTROPICAL PLANTS.**—No new varieties of the mango have been received during the year, but two varieties previously distributed have fruited, namely, the Bennet Alphonse and the Sundersha, importations Nos. 8727 and 7108, respectively. These are distinct varieties of superior merit and represent different types. Other varieties will probably fruit next year, and it will thus be possible to pass upon the quality of the varieties that are ready for distribution.

A number of shipments of tropical and subtropical plants have been made to Porto Rico, the Hawaiian Islands, and to the Panama Canal Zone. It is hoped that the Canal Zone will be found especially adapted to the culture of the mangosteen, the introduction of which into this country has so far been attempted without success. To Hawaii have been sent some 350 plants of the cacao which were raised in the Department greenhouses and are considered very valuable.

#### DISTRIBUTION OF SEEDS AND PLANTS, AND WORK CONNECTED THEREWITH.

The Congressional distribution of seeds and plants was carried on during the past year essentially as in the year preceding. The contract for packeting, assembling, and mailing vegetable and flower seeds was awarded to the Brown Bag-Filling Machine Company, of Fitchburg, Mass., at \$1 per thousand packets, this being the lowest

bid received. A total of 36,410,025 packets of vegetable and flower seeds was put up under this contract during the period from November 27, 1905, to April 25, 1906. The usual quotas of cotton seed, grass seed, bulbs, grapevines, and strawberry plants were sent out on Congressional order, the only change from the preceding year being that the tobacco-seed distribution, perviously carried out by the allotment of regular quotas, was confined to a limited distribution of seed of improved varieties, conducted in cooperation with Plant Breeding Investigations. An outline of the distribution of special seeds and plants during the year follows:

**PISTACHE DISTRIBUTION.**—During the past year the first systematic distribution of pistache seedlings raised in the Plant Introduction Garden at Chico, Cal., has been made. The plans for this distribution were carefully worked out by Mr. Walter T. Swingle, physiologist in charge of Plant Life History Investigations, and several thousand young trees have been sent to persons interested, in California, Nevada, Utah, and the Southwest. The object of this first introduction is to determine the range of territory where the pistache tree will thrive. The moisture and temperature requirements of this tree are not yet thoroughly understood, but it is believed that it will grow in a great many sections where the soil is too dry for any other useful tree. Scions from the choicer varieties have already been secured and the propagation of these varieties is going on in the greenhouses and at Chico. As soon as the preliminary distribution of the trees demonstrates where they can be grown successfully, scions of the choicer varieties will be sent to those who desire to establish this culture on a commercial basis. Some seed of hardy wild stock from Baluchistan and some of the native stock from Texas have also been secured. It is thought that these seedlings will be particularly adapted as stocks for the semiarid regions.

**MISCELLANEOUS DISTRIBUTION.**—From the Plant Introduction Garden at Chico, Cal., there have been distributed through this office in the neighborhood of 500 wood-oil nut trees, 24,000 paper plants, several thousand plants of the udo, and several thousand pistache trees, as before mentioned. These have been the principal distributions from this point, although thousands of plants of various kinds have also been distributed from the garden.

The practice of sending seeds to Alaska to be distributed under the direction of the Alaska Experiment Station authorities was continued during the year, as was also the limited distribution of special seeds and plants where there seemed to be occasion for such work. Fifty thousand packets in all have been sent to Alaska. The distribution of cotton seed, sugar-beet seed, etc., was continued as heretofore.

**SUGAR-BEET SEED GROWING.**—The work of producing a high-grade pedigreed strain of sugar-beet seed has been continued during the past year, but the work must run through one more year before a complete report of this phase of the investigations is possible. The results obtained during the year just passed have continued to be as favorable as those mentioned in the last report, and the work was carried on along practically the same lines as reported last year. The comparative tests of American and foreign grown seed show that on

an average the Kleinwanzleben sugar-beet seed grown in Washington State was superior to all others, yielding more sugar per acre than any other except the European seed of a special sort that was received only in small quantity for special experiment.

**GROWING SPECIAL COTTON SEED.**—During the past year the work of growing special strains of cotton seed, in cooperation with Dr. H. J. Webber and Mr. W. A. Orton, of this Bureau, has been continued, the disease-resistant varieties being grown under Mr. Orton's direction and the improved hybrids of Sea Island cotton under the direction of Doctor Webber. The seed secured from fields of disease-resistant cotton has been distributed, and arrangements have been made for growing a larger quantity during the current year.

**BULB GROWING.**—The experimental work on the growing of Dutch bulbs has been continued along the same lines as last year. An experiment with a private bulb-growing company has demonstrated that tulips and hyacinths, at least, can not be profitably grown under the conditions prevailing at a locality in North Carolina, and it is very doubtful whether narcissus bulbs can be profitably produced in that section. The experiments with the various fertilizers indicated that certain animal fertilizers were very injurious, whereas cowpeas turned under gave on the average as good results as any of the fertilizers. The work in this section will not be continued, but there are indications that the extreme southern part of Texas may prove very favorable for the culture of the Bermuda lily, and experiments along this line have been planned for the coming year.

**CEREAL WORK.**—The work on the introduction and adaptation of cereals has continued, as heretofore, under the immediate direction of Mr. M. A. Carleton, cerealist in charge of Grain Investigations. The work of the year has been devoted chiefly to the following subjects: (1) Introduction of Sixty-Day oat; (2) cereals adapted for the Southwest; (3) Ivanov and Abruzzes ryes; and (4) proso, or Russian millet.

Adaptation trials with the Sixty-Day early variety of oat have now been conducted on a rather extensive scale for three years, while a smaller number of tests at several of the State experiment stations have been made continuously during five years. Sufficient evidence is now at hand to leave no doubt of the value of this oat for the prairie regions of the Mississippi Valley and Great Plains between northern Oklahoma and Minnesota. The early oats are usually found in southern latitudes, but the Sixty-Day is apparently an exceptional variety in being adapted to northern localities and in being somewhat drought resistant, though it is probable that its freedom from the effect of drought is largely due to its earliness in ripening. The Sixty-Day oat was introduced from the southwestern part of Russia. It has invariably given better yields than other varieties in the area mentioned.

In the work on cereals adapted for the Southwest, further experiments with the Fretes wheat, introduced from Algeria, have given surprising results, showing it to be an excellent wheat for the Southwest and the Pacific coast. It is drought resistant and has done especially well in northwest Texas. The Galgalos wheat obtained in Trans-Caucasia is even more drought resistant than the Fretes, though



perhaps not so good in quality. It has successfully passed through the most severe drought yet encountered in our experimental work. It is perfectly hardy in severe winters.

The Beldi and Telli barleys, from Algeria, continue to give good results in the Southwest and are particularly adapted to Arizona and southern California. The Black Arabian barley, coming from Arabia, has unexpectedly proved to be winter hardy. Some improvement will make it a good winter barley, as it is also drought resistant.

The Ivanov rye, introduced from Russia, has been found by tests conducted in Maryland and Kansas to be hardier than other varieties and very productive. The Abruzzes rye, coming from the highlands of Italy, is known as a fine spring variety, but is found to be winter hardy in Oklahoma and Kansas. Fall sown, it gives excellent early pasturage and possesses besides a well-developed kernel.

In the work with proso, or Russian millet, the success with this cereal in the Northwest has been noted in previous reports. It is now found that proso is well adapted also to intermountain areas and high elevations much farther south, even in New Mexico and northwest Texas. This fact is of much value as, in the absence of corn, proso takes an important place as a stock food, being probably equal in this respect to the grain sorghums.

**FORAGE CROP WORK.**—During the past year the work on the testing and introduction of forage crops has been continued along the lines indicated in the last report under the immediate direction of Mr. C. V. Piper, agrostologist. Special emphasis has been placed upon the extension of alfalfa culture in the eastern United States and determining the exact places which the Turkestan and Arabian alfalfas may have in our farm economy. The comparative tests of alfalfas in cooperation with Plant Life History Investigations have also been continued.

The extension work on alfalfa in the East has been carried on by Mr. J. M. Westgate, assistant agrostologist, the plan followed being cooperation with any reliable farmer who is willing to carry out the plan of experiments laid down by this office, which consists of planting an acre or two of alfalfa seed, part of the land being limed, part being manured with barnyard manure, and part being inoculated with nitrogen-fixing bacteria. Certain variations of this plan were, of course, found necessary to conform to the special requirements of different localities. Where farmers were willing to carry out these experiments this office furnished the seed and outlined the work, sending an expert to observe and advise.

The work of testing the forage crops adapted to various sections of the country has been carried on during the past year at Chillicothe and San Antonio, Tex.; Chico, Cal.; Pullman, Wash.; Waterloo, Kans., and at the Arlington Experimental Farm. At each of these places such varieties were tested as it was believed would prove adapted to the local conditions prevailing. The most important testing work at Chillicothe was with sorghums, Kafir corns, and leguminous soil-improving crops; at San Antonio, sorghums and Kafir corns, with reference to drought resistance. At Chico, special emphasis was placed upon testing leguminous crops, since California soils everywhere seem to be lacking in humus, and it was hoped that crops might be found which could be grown and turned under so

that a grain or other market crop could be raised on the land the same year. At the Arlington Experimental Farm complete tests were made of all forage crops except varieties adapted only to arid or sub-tropical regions.

**VARIETY TESTS OF VEGETABLES.**—Tests of vegetable varieties have been carried on this year at Chico, Cal.; Pullman, Wash.; San Antonio, Tex., and at the Arlington Experimental Farm. A large additional amount of data has been accumulated which will be useful in the preparation of standard descriptions of the principal varieties and of important new varieties as they appear in the trade. This work is meeting with the indorsement of seedsmen and it is believed to be very important that it should be carried on until completed. In connected with the work studies on the effect of environment upon the production of seed have been carried on with sweet corn and cabbage. It has been found that environment has a marked effect upon the seed produced, but the work has not progressed far enough to state positively how far this effect will influence the commercial qualities of the seed.

The principal study of the year, however, has been with varieties of beans, including the dwarf, pole, and Lima varieties. This work has been actively pursued by Mr. W. W. Tracy, jr., assistant botanist, under the direction of Mr. W. W. Tracy, sr., superintendent of Testing Gardens, and is so far along that a report embodying a complete descriptive list of varieties of beans will be prepared in the near future.

#### PLANS FOR FUTURE WORK.

During the ensuing year the work of Seed and Plant Introduction and Distribution will be continued along essentially the same lines as heretofore. Following is a brief outline of the work in hand:

**AGRICULTURAL EXPLORATIONS.**—During the coming year the following explorers will be in the field: Mr. Frank N. Meyer, in Manchuria and northern China, where he will continue to secure seeds and plants of wild species and cultivated varieties which appear to be useful for introduction into the United States; Prof. N. E. Hansen has been sent to Scandinavia, Russia, Siberia, and Turkestan to secure hardy fruits and additional information in regard to Turkestan alfalfa; and Mr. John H. Tull will be sent to Japan and China to study the matting industry and if possible to secure seeds and plants.

**WORK WITH FORAGE CROPS AND CEREALS.**—The work with cereals during the coming year will not be carried on as extensively as in the past. Lack of funds makes it necessary to limit the work along this line, but the work on the more important introductions will be continued. In the line of forage crops, alfalfa introduction in the East will be especially pushed and an effort will be made to complete the work on Turkestan alfalfa and prepare a bulletin on the subject. Active work will be taken up on the investigation of grasses and the introduction of new varieties of timothy, and the experiments with hairy vetch in the Connecticut tobacco fields will be actively carried to a conclusion.

ESTABLISHMENT OF A PLANT STATION IN SOUTHERN TEXAS.—This office has been for some time impressed with the possibilities of southern Texas in subtropical horticulture. From time to time persons interested in this matter have written to this office and it was decided that this region was well worth a careful investigation by trained observers. Mr. O. W. Barrett, plant introducer, was therefore instructed to make such an examination and to get in touch with responsible persons with whom the office could cooperate. While Mr. Barrett was in the field the movement for the establishment of a substation in that region took definite shape, and he was further instructed to make an examination of the region with a view to the establishment of such a station. Mr. George W. Oliver, of this Bureau, was also authorized to investigate the region with a view to its adaptability to the culture of the Bermuda lily, and he also received additional instructions from the Chief of the Bureau to examine the region with a view to the establishment of a substation. Reports from both of these men have been submitted, and it is expected that the substation will be established during the coming year.

ESTABLISHMENT OF A BULB-TESTING GARDEN.—The work on the introduction of Dutch bulbs having proceeded so far that it has become necessary to make a more detailed study of the work in the Northwest by establishing an experimental garden, plans have been perfected for sending Mr. Henry E. Juenemann, gardener, who has been placed in charge of this work, to Washington State with instructions to arrange for cooperative experimental work with individuals interested in bulb culture. He will also study closely the question of a site for an experimental garden to be wholly under the control of the Department of Agriculture, and it is hoped that such a garden can be established at the close of another year.

#### SEED LABORATORY.

During the past fiscal year the work of the Seed Laboratory, of which Mr. Edgar Brown is botanist in charge, has been carried on along lines similar to those mentioned in previous reports. Investigations have been conducted along the following lines:

SEED TESTING.—On account of the increasing demand for seed testing it has been found necessary to limit the number of tests made for any one firm or individual. In this way the work is more widely distributed and only the more difficult samples are received. There have been received during the year a total of 7,261 samples. Of these 1,392 were sent in through the custom-houses, and 5,869 were from farmers, seedsmen, and from the seed purchased for Congressional distribution. Of the total number 3,712 samples have been tested for germination, 1,260 for purity, and 1,526 have been examined for the presence of adulterants or dodder.

EXAMINATION OF SEEDS FOR ADULTERATION.—The Laboratory has been charged, as heretofore, with carrying out the law requiring the testing of seed samples secured in the open market and the publication of the names of all dealers from whom samples found to be adulterated are obtained.



During the year 2,047 samples of orchard grass, Kentucky bluegrass, red clover, and alfalfa seed have been obtained from dealers. The results of the examination of these samples, showing the number found to be adulterated, together with the names of the firms by whom adulterated samples were offered for sale, have been published in Circulars Nos. 14, 15, and 18 of the Office of the Secretary. This work has shown that orchard grass is the farm seed most subject to adulteration, both meadow fescue and the rye-grasses being used as the adulterant, according to the relative prices of these various kinds of seeds.

Alfalfa and red clover seed have both been found to be adulterated with the seed of yellow trefoil. Alfalfa has also been found to be adulterated with the seed of bur clover. The bur clover used is not, however, the commercial seed offered for sale in the United States, but is a by-product from the cleaning of South American wool imported from Germany for this purpose. As was pointed out in a previous report, the only effective way of preventing the use of such seeds as yellow trefoil, bur clover, and Canada bluegrass as adulterants would be the levying on them of a duty making the price comparable to that of the seeds with which they are mixed.

As a result of the work on adulterated seeds, seedsmen are sending large numbers of samples to the Laboratory to be examined for the presence of adulterants and are giving more attention to the quality of seeds which they are offering for sale. At the same time farmers are sending a larger number of samples for testing, as they are becoming acquainted with the fact that a number of the more common farm seeds are frequently subject to adulteration.

QUALITY OF IMPORTED SEED.—Among the 1,392 samples of grass and forage-plant seeds received through the various custom-houses during the past year all qualities of seed, from the very best to the very poorest, were represented. Among the poorer of these seeds is included much low-grade red-clover seed which is imported for the purpose of mixing with that of better quality. The larger part of the low-grade seed could not be sold alone in our market. Its only use is for mixing with seeds of better quality in producing intermediate grades. The use of this class of seed is doubtless more detrimental to agriculture than the use of the various seeds which are usually considered as adulterants.

VISITS TO FARMERS' INSTITUTES.—Following the beginning made last year, about six weeks were spent during the past fiscal year in visiting farmers' institutes in Pennsylvania, in cooperation with the State board of agriculture. Short talks were given on various phases of pure seed investigations, the quality of commercial seeds, their adulterants, and simple methods of testing their purity and vitality. The results of this work have shown the time to have been well spent in offering a practicable way of bringing the importance of good seed directly to the attention of farmers.

VITALITY OF CORN.—The work on corn has been carried on during the past year in Illinois and Ohio, and the results are very striking, showing that the methods of harvesting, curing, and storing are of the greatest importance from the standpoint of the yield. The results of this work will be brought together in the form of a publi-

cation at the end of the present growing season. A Farmers' Bulletin on the "Germination of Seed Corn," has been issued during the year, pointing out the importance of testing individual ears and giving methods by which these tests can easily be made by anyone.

**GRAIN GRADE INVESTIGATIONS.**—The work on grain grading during the past year has been carried on both in this country and abroad. A representative was sent to visit the European ports in January, 1906, spending the remainder of the fiscal year in examining cargoes of grain from the United States on arrival. Some time was also spent in New Orleans, La., examining corn received for ocean shipment and also as it was being loaded on steamers. The results of the work abroad show that of the cargoes examined about 12 per cent of the No. 2 corn sold on certificate was damaged on arrival. As a result of the receipt of American grain in poor condition a general effort is being made among foreign buyers to discontinue the purchase of grain from the United States on certificate. This sentiment has recently taken definite form in the circular issued by the Liverpool Corn Trade Association announcing that both Liverpool and London will not recognize the certificates of inspection of Norfolk and Newport News, Va. The work on grain inspection is now being organized in accordance with a special appropriation made for the current year.

**PLANS FOR FUTURE WORK.**—During the ensuing year more attention will be given to the study of the quality of seeds offered on the market, including tests for adulteration. Observations will be made on the growing and harvesting of forage-plant seeds, in order to determine any natural mixtures which occur in the fields. The work on the vitality of seed corn will be continued. More attention will be given to the perfecting of methods of testing, with a view to aiding the State experiment stations in establishing seed-testing laboratories.

All farm seeds distributed will be accompanied by a statement of the results of the tests for purity and germination as determined by this Laboratory. In this way an opportunity will be given farmers to judge the importance of knowing the quality of seeds before sowing, which is the practical benefit to be derived from buying guaranteed seeds.

#### **SPECIAL LABORATORIES, GARDENS, AND FARMS.**

Under this general heading are grouped the various field headquarters of the Bureau, the reports of the respective officers in charge upon the results achieved during the past year being as follows:

##### **MISSISSIPPI VALLEY LABORATORY.**

The Mississippi Valley Laboratory, located at St. Louis, Mo., is in charge of Dr. Hermann von Schrenk. The following subjects have been under investigation during the year:

**CROWN-GALL DISEASE.**—Owing to the increasing destruction caused by the crown-gall disease in almost all forms of orchard fruits, the work of the past year was considerably enlarged over that of former

years. It has been directed mainly toward finding some method for reducing the number of diseased plants in nurseries, so as to prevent the further spread of the disease. Four types of this malady have been found, namely, the apple crown-gall, the hairy-root disease of the apple, the crown-gall of stone fruits, the raspberry, and the blackberry, and the crown-gall of the grape. The points under investigation have been (1) the question of infection or contagion, (2) the relation of the disease to propagation, (3) varietal, specific, and generic predisposition, and (4) the identity of the various diseases. The work has been carried on in Missouri and in cooperation with experiment stations and nurserymen in nine different localities of the Western States. A cooperative plot experiment is being maintained for the study of the grape crown-gall with the New Mexico agricultural experiment station. The greenhouse investigations of previous years have been repeated, using sterile seeds and sterile soil, to test the possibility of various types of the disease being communicated from one plant to another.

The results obtained in these investigations may be summarized as follows: (1) The apple crown-gall can probably be prevented very largely by careful attention to root grafting and by subsequent wrapping of the grafts with cloth, rubber, or paper. A manuscript on "The Wrapping of Apple Grafts and its Relation to the Crown-Gall Disease" was prepared during the year and published in February, 1906, as Bulletin No. 100, Part II, of the Bureau of Plant Industry. This has been distributed, and the recommendations made therein are being followed on a large scale by western nurserymen. (2) The amount of apple crown-gall, either soft or hard, either increases but little or actually decreases on trees in nursery rows as they grow older. The hairy-root, on the other hand, apparently increases with age. (3) Apple crown-gall does not spread from tree to tree. (4) The hairy-root disease is not infectious. (5) The crown-gall of the grape is contagious through the soil and may be spread by irrigation water from one vineyard to another. American varieties of grapes, like *Vitis rupestris* and its hybrids, are very resistant to the disease. Owing to the wide prevalence of the grape disease, the most probable method of combating it will consist in the growing of resistant varieties. (6) Further proof has been obtained as to the contagious nature of the crown-gall of stone fruits.

**DISEASES OF RED GUM.**—The investigation of the diseases of the red gum, begun last year, has been continued at various points in the Mississippi Valley. The diseases of the living tree were investigated, particularly the form of rot which destroys thousands of feet of gum timber every year after it is cut. The life history of this fungus was determined and a large quantity of timber was given a treatment as a preliminary test to ascertain whether the destruction could be prevented. The treatment showed an increase of 20 per cent in the quantity of lumber cut, meaning almost a total prevention. Treatments on a larger scale are in progress, and a bulletin on the subject has been prepared. In addition to this treatment a method of drying the green logs in the woods, in order to rid them of water quickly, was tried. The high water content makes the wood particularly susceptible to fungus attack. The preliminary tests were very suc-



cessful, showing that about 30 per cent of the water was taken out in about five weeks. Both methods of treatment mentioned are being tried by lumbermen on a commercial scale.

**STAIN IN WOOD PULP.**—Black and yellow stains frequently develop in ground and stored wood pulp, rendering it unfit for paper making or, at least, reducing the quality of the pulp. During the past year much trouble was experienced in several warehouses because of these fungi. Their manner of development was investigated and preventive measures were tried. Large fans and air shafts were constructed in the warehouses, which have apparently prevented the further development of the stain-producing fungi.

**BLUE STAIN OF WOOD.**—The investigations of the fungus causing the blue sap stain have been continued with the object of finding further methods for preventing its development. It has been studied particularly in connection with the wood of the tulip tree and the red gum. A number of new piling schemes were tested. Field tests with Norway and white pine were continued on a large scale, and the results obtained showed that efficient methods costing not to exceed 10 cents a thousand feet can be used for preventing this trouble, which results annually in losses aggregating from 6 to 7 millions of dollars.

**DISEASES OF OAKS AND OTHER HARD WOODS.**—The work on the diseases of hard-wood trees has been carried on in numerous localities, and an increased amount of information has been obtained. Owing to the nature of the problem, however, it is not yet possible to predict definite results. One of the immediate results obtained concerns the destruction caused by a fungus which attacks poplar trees. These trees are becoming more valuable every year for pulp-wood purposes, and the younger trees are very susceptible to the fungus. The investigations have shown at what age the trees become infected, the extent of the damage done, and how diseased trees may be readily distinguished. Another definite result obtained deals with the susceptibility to decay of red-oak timber. Timbers cut at different seasons were exposed to decay, and the results show how one may recognize diseased wood, what fungus forms are dangerous, and how long such wood can safely be held before being used, all of which points have a great practical bearing in the use of this material. Investigations have also been begun of the disease of the tupelo gum, similar tests to those for the red gum being made. The tests include drying the wood in the log, determining the effect of girdling, and means for the prevention of end-rot.

**DISEASES OF CONIFEROUS TREES AND TIMBER.**—The red-heart disease of conifers was investigated to determine its distribution, the amount of damage caused, and other factors. Data have been obtained of an important character with reference to the susceptibility of the various species to this disease and the influence of soil and atmospheric conditions on its prevalence.

**FENCE-POST TREATMENT.**—The method devised for treating fence posts reported last year has been still further developed. A very much simpler apparatus than that originally used, consisting of a barrel or other tight heating tank with a heating pipe, was tested with success, and practical applications on a large scale have already been made with this method.

MISCELLANEOUS INVESTIGATIONS.—A serious disease of parsnip roots which has made its appearance within the last two years in the Mississippi Valley was investigated. The nature of the disease appears to be an obscure one, and further work is in progress. A twig blight of cedar prevalent in the West was investigated, and remedial measures have been worked out. Much other miscellaneous work has been carried on during the year, such as determining material for correspondents, work on dry-rot fungi, life history studies of wood-rotting fungi and their relation to fungicides, in particular to coal-tar products.

PLANS FOR FUTURE WORK.—The work for the ensuing year at the Mississippi Valley Laboratory will include a continuation of the investigation on the important problem of the crown-gall disease and methods of reducing its destructive effects, and in connection with this work the various root-rot diseases of fruit trees will be investigated. The work on the decay of construction timber, particularly of red gum, tupelo gum, cypress, oak, and other hard woods, including the problem of the "red beech," will be given much attention. A serious leaf-dropping disease of the white pine very prevalent in the Appalachian regions will be investigated. There will also be a general continuation of the investigations of the problems of forest-tree diseases.

#### SUBTROPICAL LABORATORY AND GARDEN.

The Subtropical Laboratory and Garden, which is located at Miami, Fla., during the first half of the past fiscal year was, as in former years, under the immediate direction of Prof. P. H. Rolfs, pathologist. At the beginning of the present calendar year Professor Rolfs resigned to become director of the Florida Agricultural Experiment Station, and was succeeded as pathologist in charge by Dr. Ernst A. Bessey, of the Bureau of Plant Industry. Doctor Bessey makes the following report on the operations of the past year, which is necessarily brief, owing to his having taken charge of the work at such a recent date.

DISEASES OF TROPICAL AND SUBTROPICAL PLANTS.—In the study of diseases especial attention has been given to those caused by the fungi belonging to the genera *Gloeosporium* and *Colletotrichum*. It has been shown by inoculations made in the garden, as well as in the laboratory, and by close study of pure cultures in the laboratory, that these anthracnoses are caused by the same fungus on many subtropical and tropical plants, for instance, citrus fruits, the cashew, mango, and avocado, the fungus causing the disease of these plants being *Colletotrichum gloeosporioides*. These fungi produce various effects. When they attack the flowers they cause blossom-blight; the young twigs, wither-tip; the older leaves, leaf-spot; immature fruits, rot, and nearly mature fruits, depending on the severity of the infection, either rot or tear-stain. The methods worked out for the control of the disease in citrus fruits have been found applicable, with only minor modifications, to the other fruits. In addition to this work on fungous diseases, some attention has been given to a serious leaf disease of the pineapple, but without results thus far. Other minor diseases have been investigated as the necessity has arisen.

PROPAGATION OF TROPICAL AND SUBTROPICAL FRUITS.—In the work on fruits particular attention has been devoted to developing methods of asexual propagation in order that choice varieties may be perpetuated in this manner. Mr. P. J. Wester, special agent, has been successful in budding the sapodilla, showing the practicability of obtaining choice varieties by selection or hybridization and by propagating them asexually instead of growing seedlings, as has been the practice hitherto. Already many choice seedling trees on the Florida Keys have been marked and will be propagated from at the earliest opportunity.

Success has also been obtained by Mr. Wester in working the sugar apple, custard apple, and cherimoya upon the native pond apple, the latter being a hardier plant and presumably a better stock for these more tender tropical fruits. Considerable attention has been given during the past year to breeding improved varieties of the papaya (*Carica papaya*). Several thousand seedlings from choice fruits and from different parts of the world have been grown at the garden, and those of superior merit have been selected. Success has been obtained in propagating this plant by inarching, and somewhat limited success in obtaining growth from cuttings. The work in this direction is still in progress. Methods of budding the avocado have been so perfected that it is no more difficult to bud this fruit than citrus fruits. The result of this is that the avocado is beginning to be planted in the form of trees budded to known varieties, instead of in the form of seedlings. The tamarind was also found by Mr. Wester to be easily propagated by budding.

VANILLA EXPERIMENTS.—A shed giving partial shade and protection from the cold in winter has been built at the garden, in which have been planted cuttings of vanilla obtained from the Bahamas, South America, Central America, Mexico, and Hawaii, as well as three species native to Florida. In all, 8 or 10 species are now under investigation. It is intended to adapt the methods of cultivation to the conditions of Florida, if possible, and to use the different species for the purpose of hybridization.

MANGOS.—Of the mangos imported by the Office of Seed and Plant Introduction and Distribution, a considerable number have been placed at the Subtropical Laboratory and Garden, to be grown and used as standards for identification and use in a contemplated monograph of mango varieties. But one of these sorts has fruited this year, the Sundersha, which is found to have very large fruits, ripening very late and being of good quality. It is expected that other varieties will come into bearing next year.

NEMATODE WORK.—The investigations of diseases of plants due to nematodes has been carried on both at the laboratory and at Monetta, S. C. The list of plants subject to attacks of the root-knot nematode (*Heterodera radiculicola*) has been increased to about 315, and doubtless will be further increased during the coming year. Numerous infection experiments in sterilized pots have shown that the nematode attacking the commoner cultivated plants is not specialized into races peculiar to these plants, but that the nematodes will attack any of these plants indiscriminately. These experiments will be carried as far as possible in order to determine whether, for some plants, at least, there may not be specialized races.



## PLANT INTRODUCTION GARDEN.

The Plant Introduction Garden, located at Chico, Cal., is in charge of Mr. P. H. Dorsett, pathologist. The garden is becoming more and more useful in the demonstration of numerous special problems under investigation, many lines of cooperative work now being under way, which are outlined in the following paragraphs. The present appropriation bill authorizes the erection of a permanent building at the garden, and it is hoped that it may be completed before the close of the ensuing fiscal year.

**GENERAL IMPROVEMENTS.**—The irrigating system at the garden is being extended along lines which will make it efficient and satisfactory when completed. Additional land has been graded for irrigation preparatory to general and permanent planting. About 20 acres of slough land, which is rough and otherwise largely waste, has been partially cleared, put into shape, and is being planted to economic and ornamental trees, shrubs, and other plants. Necessary fences, temporary buildings, lath houses, arbors, and bridges have been constructed, and much miscellaneous work incident to the garden, which is 80 acres in extent, has been undertaken.

**SEEDS AND PLANTS RECEIVED AND DISTRIBUTED.**—A vast amount of miscellaneous material, including seeds, buds, scions, cuttings, etc., was received at the garden, much of this being sent through the Office of Seed and Plant Introduction and Distribution from China by Mr. Frank N. Meyer, agricultural explorer. Specimens of a majority of this material have been propagated successfully. A total of 53,270 plants have been distributed from the garden during the year.

**FORAGE CROP WORK.**—In cooperation with the Office of Seed and Plant Introduction and Distribution about 500 varieties of sorghums have been tested during the year, and about 500 varieties of grasses and legumes are being grown. In the work on grasses and legumes observations and notes relative to their value for forage, soiling, green manure, hay, cover crops, etc., are being made, the work promising good results. Sufficient seed of a number of the plants, including two promising varieties of bur clover, will be on hand for additional tests next season at the garden or for field tests and demonstration work. Mr. Roland McKee, who was detailed to this office in January, has devoted his entire time to observations and note-making in this work and in the vegetable tests described in the next paragraph. It is the intention to continue and enlarge this work at the garden and to extend it into field demonstrations.

**COOPERATIVE VEGETABLE TESTS.**—The work on vegetables is also carried on in cooperation with the Office of Seed and Plant Introduction and Distribution, embracing the testing of about 500 varieties, including peas, beans, beets, onions, radishes, cabbage, cauliflower, tomatoes, sweet corn, and melons. The work involved the compilation of complete descriptive notes, together with notes on yield tests and other qualities, disease resistance, hardiness, etc., which will be of assistance in identification and in the determination of the relative value of varieties. The results of this work have so far been satisfactory, and it will be continued during the coming year.

**ALEURITES CORDATA.**—Plants grown from seed of *Aleurites cordata* obtained from China through Consul-General L. S. Wilcox have received considerable attention, and a new industry in growing the material from which to manufacture the higher grades of oil for paints, varnishes, etc., is within the range of possibility. Several hundred of these plants are on hand, which were grown from seed last year and used during the spring of 1906 to demonstrate the possibility of successfully transplanting them. The test was highly satisfactory, and the work along this line will be continued.

**GRAPE EXPERIMENTS.**—Twelve acres of the garden have been set aside for experimental work on grapes, in cooperation with the Office of Field Investigations in Pomology. Cuttings to the number of 4,180 were rooted at the garden last season. A number of these, together with 1,454 imported vines and several thousand cuttings, were distributed during the past spring among the experimental vineyards maintained by the Bureau in different parts of the State of California and to individuals in that and other States. Fully 25,000 cuttings were received and planted at the garden this spring. In the varietal vineyard were planted two vines each of 120 varieties. These have made a very good showing.

**COOPERATIVE APIARY.**—By arrangement with this Bureau, the Bureau of Entomology has established an apiary at the garden, with Mr. J. M. Rankin, special agent, in charge. The work embraces observations as to the honey and pollen yielding capabilities of the various plants introduced at the garden, and also of native and other plants throughout the State. Other apicultural investigations, such as bee diseases, breeding, and selection, are conducted. It is planned to continue and extend this work, the expense of which is borne chiefly by the Bureau of Entomology.

**MISCELLANEOUS COOPERATIVE WORK.**—In addition to the work outlined in the foregoing, the garden is carrying on cooperative work on the pistache nut with the Office of Seed and Plant Introduction and Distribution and that of Plant Life History Investigations.

About 16,000 seedling trees of the various varieties were propagated last year. Approximately one-fourth of these have been distributed, mainly through California, Texas, and Arizona. A large number of trees will be ready for distribution this fall. Permanent plantings of budded varieties for further experimental work have been commenced.

Permanent plantings of figs at the garden include 19 varieties of true figs and 13 varieties of caprifigs. During the last spring cuttings of the "Chiswick collection" at Niles, Cal., were secured, the grafts of which were originally furnished by the Department. These will be added to our collection as soon as they are large enough to plant in the field, and will be used for further experimental work.

About 1½ acres in the garden have been planted to cacti, including about 150 species and varieties, for future experimental work, which will be prosecuted when the plantings are sufficiently developed. In the work on matting grass, 8,250 seedlings of *Juncus effusus* grown from seed of importation No. 9873 of the Office of Seed and Plant Introduction and Distribution were furnished for the experiments conducted with this grass at Georgetown, S. C., as were also 1,825 plants

of a bluestem form, native at the garden, and 8,250 plants of *Elycocharis palustris*, propagated from plants secured at Antioch, Cal. This work possibly represents a new industry to the United States, and will be continued during the coming year.

#### COTTON CULTURE FARMS.

The Cotton Culture Farms, of which Dr. S. A. Knapp is special agent in charge, with headquarters at Lake Charles, La., are the result of the "Farmers' Cooperative Demonstration Work" inaugurated in January, 1904, at the request of the Texas farmers who had lost their cotton crop through the ravages of the boll weevil, in order to demonstrate that a crop of cotton could be successfully produced with the boll weevils abundant in the fields. The demonstrations include corn, cowpeas, and the use of commercial fertilizers—corn as a rotating crop, cowpeas to renovate the soil, and commercial fertilizers to stimulate the rapid growth and early maturity of the cotton so essential to success under boll-weevil conditions. Such methods only are recommended as have been approved by scientific investigations and the test of the best farm results, and to most of the cooperating farmers cotton and corn seed of valuable varieties is furnished, under an agreement that this seed shall be planted and cultivated, and the seed from the crop selected and stored, according to instructions.

A central office was established and agents were employed during the fiscal year 1905. Central and southern Texas and western Louisiana were very thoroughly covered by the demonstration work, and more than 8,000 farmers cooperated to establish and conduct demonstrations. In addition to these, many thousands followed instructions but did not report results.

WORK OF THE YEAR.—During the past fiscal year the work has been extended to include northern Texas, all of Louisiana, western Mississippi, and portions of Arkansas and western Tennessee. In addition to the general cooperative demonstrators, 349 special farms were established in the States mentioned, under the full supervision of the field agents. The object of the special demonstration farms is to carry out more perfectly the instructions approved by the Bureau and thereby make a more striking demonstration of the success obtainable, and also to secure more accurate reports as to results. The influence of these special farms has been much greater than was anticipated.

The results of the past year show that the work was widely influential in the adoption by farmers of better methods of preparing the soil and cultivating the cotton crop, in securing the selection and planting of the best seed, and in the improvement of soils by rotation of crops and the use of cowpeas. All farm reports, whether of the special farms or of cooperators, have been recorded in books kept at the central office. The special farms have been visited by the field agents every month, or more frequently if required. The State agricultural colleges and experiment stations, the press, the farmers' institutes, and various agricultural organizations have rendered valuable assistance to the work.

PLANS FOR FUTURE WORK.—During the ensuing year the plan arranged is to continue the cooperative work in Texas, Louisiana,



and Arkansas, to considerably increase the work done in Mississippi, and to extend it to cover Alabama. It is the intention to employ 24 district field agents in all, who will each be instructed to accept not to exceed 8,000 cooperating farmers who are willing to follow the instructions of the Department of Agriculture and thus demonstrate the advantages to be gained by better cultural methods. These field agents will establish about 700 special farms widely distributed, which will be under their personal supervision and will be conducted as object lessons in the better management of soils, in the importance of using the best seed, and in selecting and storing the seed. Our instructions will mainly be limited to the methods by which a larger yield of cotton per acre can be secured; the necessity for a reduction of acreage in cotton upon each farm in order to provide for renovating crops; the establishment of some simple and practical system of rotation to renovate the soil, and the production of an abundance of corn and cowpeas as an auxiliary to successful cotton growing.

Quarterly meetings of the district agents will be held in each State for consultation and instruction, and a general meeting of the State cooperators will be held at the close of the year. Close central control of all farms and cooperators will be continued.

The effect of cooperative work in the States where it has been conducted for two or more seasons has been to produce a marked and general change in methods, resulting in better preparation of the soil and more thorough cultivation of the crops, the use of well-bred seed adapted to the soil and climate; and in general the adoption of a system of husbandry that under normal conditions has assured results. Every effort will be made to secure during the ensuing year the cooperation of all the forces in each State working for the general uplift of agriculture.

## REPORT OF THE FORESTER.

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U. S. DEPARTMENT OF AGRICULTURE,  
FOREST SERVICE,  
*Washington, D. C., November 15, 1906.*

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1906, together with an outline of the plans for the work of the Service for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,  
*Forester.*

HON. JAMES WILSON, *Secretary.*

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### SUMMARY.

The most important facts concerning the Forest Service during the past year were:

A marked improvement in the efficiency of the force on the forest reserves, due to the progressive education of the men in their duties and the removal of incompetent or otherwise undesirable members.

A marked increase in cooperation between office and field men and the disappearance of any divergence in their points of view and attitude toward the common work. In this all the offices of the Service have cooperated, but special mention should be made of the Office of Record.

The collection for the first time of a fee for grazing on the forest reserves. After the first protests, unavoidable but remarkably few in number, the fees were paid without friction or ill will, thanks in large part to the appointment of advisory boards by local associations of stockmen at the invitation of the Forest Service.

A remarkable increase in the amount of timber sold from the forest reserves and given away in free use, and a still more remarkable decrease in forest fires. But three-tenths of 1 per cent of the forest reserves suffered from fire during the summer of 1905.

A very striking increase in the use of the reserves by the people of the West and in their good will and support to the forest policy. Opposition to the forest reserves is substantially at an end. It has been replaced by a rapidly growing cooperation and approval.

It is due to members of the Forest Service to say that, in spite of the greatly increased responsibilities and pressure of other work which followed the transfer of the forest reserves to the care of the Forest Service, they contributed notably to the work of the assistant committees of the Committee on Department Methods.

## PUBLICATION AND EDUCATION.

There was received in this section 40 manuscripts, containing, in all, 1,981 typewritten pages. Of these manuscripts 29 were sent to the printer, 3 were returned to the originating offices for forwarding to persons outside the Service, 3 were returned or withdrawn for emendation or the addition of further matter, and 5 were found unavailable for publication.

There were also prepared 17 original articles as memoranda for reports, addresses, and similar purposes.

Proofs of 38 publications, aggregating 892 printed pages, were handled.

On March 12 this section was assigned the preparation of printing requests and care of the file and record of routine printing, including the review of all forms. During the remainder of the year 255 printing requests were made out. The total number of printing requests for the year was 795.

Nine new publications were issued, with a total of 198,000 copies. Bulletins issued were: Forest Reserves in Idaho; A Working Plan for Forest Lands in Central Alabama; and Grades and Amount of Lumber Sawed from Yellow Poplar, Yellow Birch, Sugar Maple, and Beech. Of circulars of information there were issued: The Forest Service—What It Is, and How It Deals with Forest Problems; Forest Planting in the Sand-Hill Region of Nebraska; Instructions for Use of Instruments in Surveying; Revised Regulations and Instructions in Reference to Grazing; and The Use Book. Four reprints of Yearbook articles were issued: How to Grow Young Trees for Forest Planting; Waste in Logging Southern Yellow Pine; Prolonging the Life of Telephone Poles; and Progress of Forestry in 1905. Reprints of 24 bulletins, 15 circulars, and 6 Yearbook extracts were made, with a total of 191,000 copies.

On June 30, 1906, 3 bulletins and 2 circulars were in the hands of the printer.

During the year 58 press bulletins were prepared and issued, with a total circulation of 406,100 copies.

There were printed, for use in supplementing correspondence, 11 forest planting leaflets, with a total circulation of 27,000 copies. Near the close of the year a series of trade bulletins, embodying news of a technical nature, was begun.

Educational work through addresses was greatly extended during the year, both in the number of meetings held and in the territory covered. Systematic work was carried on in Kansas, Oklahoma, and Alabama, and 23 individual meetings were addressed upon special request in 14 States and 1 Territory. Many of these addresses were illustrated by lantern slides. On several occasions a representative of the Service accompanied the "corn specials" which were run to carry exhibits of progressive farm methods.

## WORK OF THE COMING YEAR.

Besides handling printing requests, reviewing all forms and other work submitted for printing, reading proofs, revising manuscripts, and preparing such occasional articles as may be required, the work of the coming year will spread information concerning our forest resources and forest use through making ready special publications



in popular form, through cooperation with teachers and officers of public instruction, and through further systematization and extension of lectures and addresses.

### SILVICS.

The work of the year in Silvics followed two main lines—collecting, critically examining, and systematically organizing the data already gathered by past studies of the Forest Service or accessible from other sources, and establishing permanent sample plots for gathering new data.

A knowledge of the requirements of the various species which form the forests of the United States, and of their behavior under varying conditions, is the foundation of intelligent forest management. Yet the vastness of our forested area, the wide range of climatic and other conditions, and the great number of species found make the gathering of this knowledge a huge task, which systematic study by foresters has only begun to attack. The problems of management which the care of the national forests imposes upon the Service makes the need of such knowledge urgent.

During the year data were compiled for 67 species. Their range, rate of growth, light, moisture, and soil requirements, reproduction, and behavior in pure stands and in competition with other species were among the subjects treated. At the same time notes were gathered as to the silvical conditions of 41 of the forest reserves.

Work on permanent sample plots was done chiefly on loblolly pine in South Carolina and Maryland, white pine in Massachusetts and New Hampshire, and red spruce in New Hampshire. A less amount of work was done on thinnings in chestnut coppice in mixture with white and red oak and other species in Connecticut; on yellow birch in mixture with paper birch, sugar maple, black cherry, and other species in New Hampshire, and on scrub pine in Maryland.

The study of loblolly pine in Maryland was to learn, first, what different densities of seedling stands will produce, and what constitutes a full stand; second, the effects of thinnings in even-aged stands at various stages. Separate series of plots were established in pure stands on several different soils. A few plots were taken in stands where loblolly was growing in mixture with hardwoods. The plots are in Worcester County, where the growth is rapid, where the greater part of the land is probably better suited for growing pine than for agriculture, and where much land formerly under cultivation is now going back into even-aged stands of loblolly.

The South Carolina plots deal also with the effects of fire.

The white pine plots in Massachusetts and New Hampshire will furnish data concerning thinnings in young stands, the effect of thinning upon partially suppressed trees and their ability to recover after the removal of larger trees, and thinning in an overcrowded stand of pine.

### WORK OF THE COMING YEAR.

New sample plots will be laid out in the North and Middle Atlantic States. Data will be gathered concerning red spruce, balsam, white pine, and mixed hardwoods. Among the subjects of investigation will be the effect of different methods of planting, thinning, and lumbering upon the present and future forest.

## LAW.

During the year highly satisfactory progress was made in the legal work of the Forest Service. Actions for trespass were better handled than before; settlements for trespass were secured in large amounts and upon conditions just both to the Government and the trespasser, and cooperation between the Forest Service and the United States district attorneys was made effective. Trespassers who refused to make adequate settlement were refused privileges upon the reserves. The general result was to reduce the number of court prosecutions and to collect damages of \$39,224.96 for the year.

In a few aggravated cases suits were brought and resulted in settlements for damage, ejectment from the forest reserve, restraining injunctions, fines, and imprisonment. A supervisor in southern California was convicted for continued falsification of his accounts prior to the transfer of the forest reserves to the Department of Agriculture, and was sentenced to three years' imprisonment, with a fine of \$7,000. Immediately upon the creation of the Hell Gate Forest Reserve a timber trespass was discovered and stopped, and though the damages were settled for nearly \$20,000, it is worthy of note that this trespasser has since purchased \$200,000 worth of timber from the same reserve.

Through the Section of Law the Forest Service asserted the right to charge for use of forest reserve resources, contrary to the position previously held in the Interior Department. The Attorney-General upheld this right, which is the basis for all forest-reserve receipts except those from timber, amounting to \$522,306.47 during the fiscal year of 1906. This decision was and is of extreme importance.

The transfer of the forest reserves made it necessary to determine the respective jurisdictions of the Departments of the Interior and of Agriculture. After long and careful consideration it was agreed that the administration of all laws affecting the title to forest-reserve land remained with the Department of the Interior, and that of other laws, which govern the administration, protection, and use of the forest reserves, fall to the Secretary of Agriculture. The cooperation made necessary by this division of jurisdiction was conducted through the Section of Law. A thorough study was therefore required of all the public-land laws and previous administrative regulations, and particularly of right-of-way and land claims of all kinds.

The President expressly asked both the Secretaries of Agriculture and the Interior to cooperate fully in the administration of laws affecting forest reserves. Accordingly certain modifications of policy and practice were secured to protect Government rights and interests and to give effect to the intent of Congress in its later land legislation. The following necessary and important changes followed:

(1) The acceptance of the Forester's finding of facts concerning land claims within forest reserves. (2) Definite notice to be given by the General Land Office to the Forest Service of a claimant's intention to make final proof. (3) Refusal by the General Land Office to issue final certificate or allow final entry for any land claim within a forest reserve, against which a forest officer has protested, until full hearing before the local land officers. (4) The requirement of such stipulation and bond as the Forester may demand to protect forest-reserve interests before the approval of rights of way

within forest reserves. (5) The recognition of the right of the Government to withdraw from all appropriation areas within forest reserves needed for administrative use. (6) The right of the Government to withdraw specific land from coal entry. (7) The right of the Government to withdraw for public use land already withdrawn or reserved, when the purposes of the two withdrawals are not inconsistent. (8) The principle that withdrawals for prospective forest reserves do not interfere with the use of the land, except to save the title to the Government. (9) The right of the Secretary of the Interior to investigate and determine the validity of mining locations or settlement claims, especially on forest reserves, prior to entry or application in his Department.

The Section of Law scrutinized all contracts before they passed to the Forester for his signature, and constantly advised other officers of the Forest Service upon matters involving questions of law.

Many acts and joint resolutions affecting the Forest Service were passed by the Fifty-ninth Congress at its first session, and approved by the President, which may be briefly summarized as follows:

Provisions of the homestead laws extended to certain lands in Yellowstone Forest Reserve (34 Stat. L., 62). Permit granted to the Edison Electric Company for power plants in the San Bernardino, San Gabriel, and Sierra Forest reserves (34 Stat. L., 163). Cutting, chipping, or boxing of trees on the public lands for turpentine forbidden (34 Stat. L., 208). Historic and prehistoric ruins, monuments, and objects of antiquity, many of them on forest reserves, protected; permits for excavation and collection (34 Stat. L., 225). Agricultural lands in forest reserves to be examined for opening under the homestead laws (34 Stat. L., 233). Lands granted to the State of Wisconsin for forestry purposes (34 Stat. L., 517). A game preserve within the Grand Canyon Forest Reserve to be designated by the President (34 Stat. L., 607). The forest reserve special fund continued until otherwise provided by law; to be expended after June 30, 1908, only in accordance with specific estimates for each succeeding fiscal year (34 Stat. L., 684). Ten per cent of receipts from forest reserves to be paid to the States for public schools and roads in the counties in which the forest reserves are situated (34 Stat. L., 684). Sales of forest-reserve timber in California made uniform with other States (34 Stat. L., 684). Exportation of timber from the forest reserves in Idaho and of dead and insect-infested timber from the Black Hills Forest Reserve authorized (34 Stat. L., 684). Refund of excess payments to depositors authorized from forest reserve special fund (34 Stat. L., 684). Purchase of law books for the Forest Service authorized (34 Stat. L., 685). Fifteen thousand dollars appropriated for fence and sheds on the Wichita Forest Reserve for a buffalo herd (34 Stat. L., 696). Five thousand dollars appropriated to enable the Secretary of the Interior to pay the expense of advertising the restoration to the public domain of lands in the forest reserves (34 Stat. L., 724). One hundred thousand dollars appropriated for continuation of the survey of public lands in the forest reserves (34 Stat. L., 728). Lands in Leadville Forest Reserve granted to the town of Tincup for cemetery purposes (34 Stat. L., 796). Granting to the city of Los Angeles rights of way for the city water supply through the Santa Barbara, San Gabriel, and Sierra forest reserves (34 Stat. L., 801). The re-cession by the State of



California of the Yosemite Valley grant and the Mariposa Big Tree Grove accepted, and these lands included in the Yosemite National Park; certain lands excluded from the park and added to the Sierra Forest Reserve (34 Stat. L., 831). Protecting copyrighted matter in Bulletin No. 71, "Rules and specifications for the grading of lumber adopted by the various lumber manufacturing associations of the United States" (34 Stat. L., 836).

After the transfer of forest reserves to the Department of Agriculture there were increased efforts to secure rights on the reserves, both by perfecting title to the land and by obtaining special privileges and rights of way. Supervision of matters of this kind has been in the hands of a section called "Claims and Privileges," which, before the middle of the fiscal year, was, for administrative reasons, divided into two sections under the Section of Law in the Office of the Forester. On July 1, 1906, the sections of Law, Claims, and Privileges were combined to make the Office of Law.

#### CLAIMS.

From February 1, 1906, to the end of the fiscal year 486 claims reports were obtained from the field and transmitted to the General Land Office with recommendations.

Steps were successfully taken to secure an investigation of alleged fraudulent mining claims in the different forest reserves, in one of which an association of eight persons has located 265,000 acres under the placer mining laws. Until the validity of these locations has been determined the Forester can neither sell nor grant the free use of timber from them, while the locators are restrained by law from cutting timber except to develop the particular claim where it grows. Under these conditions the business of this locality must stagnate, for few of these claims can be worked for mineral. The Secretary of the Interior has detailed three geologists, an attorney, and a special agent to examine the validity of these locations, in cooperation with an attorney from the Section of Law.

The Section of Claims handles in the office all applications under the agricultural settlement act of June 11, 1906. Applications under this law to July 1 indicate that their number will finally reach well into the thousands. Steps were taken to examine the land as promptly as possible.

The Section of Claims furnished information to all branches of the Forest Service concerning title to lands in established or proposed forest reserves.

#### PRIVILEGES.

The Section of Privileges has received an ever increasing number of privilege applications. After this section was joined to the Section of Law a carefully considered effort was made to restore, as far as necessary, the policies under which privileges should be granted.

The underlying principles to be followed, set forth in the first edition of The Use Book, were:

(1) That forest reserve resources are for the use of the people and no privileges will be denied unless their exercise materially interferes with reserve interests or threatens harm to the public.

(2) That a reasonable charge should be made for all such use whenever the permit involves withdrawal of the particular resource or land from use by the people in general.

(3) The charge, however, may probably be remitted (*a*) when the use granted will result in direct benefit to the forest reserve or its administration, as with telephone lines, wagon roads, trails, etc.; (*b*) when the use is by another branch of the Government, by a State, county, or municipality, or by private individuals or associations of persons for the use of water to develop their own land and not to be sold commercially.

The basis upon which charges in connection with the use of water should be calculated was definitely determined as follows:

(1) A charge per mile for the length of the ditches, conduits, pipe lines, transmission lines, etc. This applies when no greater width is allowed than that actually necessary at any one point for the enjoyment of the privilege.

(2) A charge per acre for land actually granted for occupancy, as areas flooded by reservoirs, land for power houses, residences, hotels, fenced pastures, etc.

(3) A charge for the conservation of the water supply and the use of advantageous locations and other privileges. The water itself is granted by the State, not by the United States.

Thus, in a permit for a project to develop electricity the charge would be based upon: First, the length of the conduits, transmission lines, etc.; second, the area occupied by power houses, reservoirs, etc.; third, the conservation of the water supply and the advantageous location which makes it possible to obtain a fall to turn the water-wheel. The policy assumes that amount of water used is a proper measure of its conservation by the forest reserve, and that the horsepower developed at the wheel, since it results from the water conserved and from the fall furnished, is a proper measure of the entire conservation furnished by the Forest Service to the permittee.

During the fiscal year just ended 965 privilege applications were received. Of this number 662 were approved, 35 were rejected, and 268 were awaiting reports from the forest supervisors, either because recently received or because depth of snow prevented intelligent field examination.

The work of the Section of Law during the past year was of the utmost advantage to the Forest Service.

#### FOREST RESERVES.

During the past year the chief effort of the Forest Service was to increase the usefulness of the National forest reserves. Definite progress was made along the following main lines:

(1) The division of the reserves into three districts, with an officer in charge of the organization, equipment, protection, and other purely administrative matters for each district. These district officers are stationed in Washington, directly under the Forester, and act through him. They cooperate in all matters under their charge with the various offices of the Service. The chiefs of these offices issue instructions in their own lines of work to all field officers on the forest reserves in all matters except such as require action by the For-

ester. To insure uniformity of action and to avoid possible conflict, all instructions and letters from the separate offices pass over the desk of the district officer concerned. In questions involving subjects in more than one office a decision is reached through cooperation.

(2) The organization of the inspection, both of the technical and business management of the forest reserves and of all other branches of the Forest Service. The section of inspection was not intended to reduce the actual supervision of field work by the separate offices, but to concentrate general inspection directly under the Forester. As rapidly as practicable, men who by special training and experience are fitted to inspect forest work, in one or more of its branches, were assigned to the Section of Inspection. The inspectors in no case give orders, but make themselves useful on the ground by consultation with the men whose work they inspect. They report directly to the Forester on the efficiency and integrity of the personnel.

(3) Marked improvement in all branches of forest reserve work, resulting from the assignment of specific duties upon the reserves to each office in the Service within its own field.

(4) Greatly increased responsibility laid upon reserve officers. As rapidly as possible the duties of the Washington office toward the forest reserves are being reduced to general administration, scientific investigations, inspection, and record.

(5) The publication of a second edition of The Use Book, or regulations and instructions for the use of the National forest reserves, in which the whole service cooperated. This edition shows a gratifying advance over the first edition in simplicity and the practical application of general policies to the settlement of questions on the ground, and goes far to standardize technical methods on the forest reserves. It has greatly promoted the use of the reserves.

(6) Increase in the spirit and effectiveness of the reserve force by constant intercourse between field and office, by the vigorous application of civil-service rules, by the removal of unfit members of the force, and by frequent inspection, which gives help and encouragement to local officers.

Six supervisor's meetings were held at convenient points, whose attendance included nearly all forest supervisors. At these meetings the regulations and instructions of The Use Book were fully explained, and unsettled questions arising in the local administration of the forest reserves were thoroughly discussed.

The total area of National forest reserves on June 30, 1905, was 85,693,422 acres. During the past fiscal year new reserves have been created, with a total area of 21,586,957 acres (including additions to existing reserves amounting to 9,163,458 acres), and eliminations were made to the extent of 281,241 acres. The total area on June 30, 1906, was therefore 106,999,138 acres.



*Forest reserves, showing new reserves, additions, and eliminations, July 1, 1905, to June 30, 1906.*

State.	Reserve.	Area July 1, 1905.	Changes in area by proclamations, July 1, 1905, to June 30, 1906.	
			New reserves and additions.	Eliminations.
		<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Arizona .....	Tonto .....		1,115,200	
	Black Mesa .....	1,658,880	371,360	
	Prescott .....	423,680		
	Grand Canyon .....	2,307,520		
	San Francisco Mountains .....	1,975,310		
	Santa Rita .....	387,300		
	Santa Catalina .....	155,520		
	Mount Graham .....	118,600		
	Chiricahua .....	169,600		
	Pinal Mountains .....	45,760		
California .....	Diamond Mountains .....		626,724	
	Sierra .....	4,392,840	658,160	1,066
	Tahoe .....	136,335	702,502	
	Shasta .....		1,377,126	
	San Gabriel .....	555,520		125
	Yuba .....		524,287	
	Monterey .....		335,195	
	San Luis Obispo .....		363,350	
	Stanislaus .....	627,780		
	Santa Barbara .....	1,838,323		
	San Bernardino .....	737,120		
	San Jacinto .....	668,160		
	Trabuco Canyon .....	109,920		
	Warner Mountains .....	306,518		
	Modoc .....	288,218		
	Plumas .....	579,520		
	Trinity .....	1,243,042		
	Klamath .....	1,896,313		
	Lassen Peak .....	897,115		
Colorado .....	Holy Cross .....		990,720	
	La Sal .....		29,502	
	Fruta .....		7,680	
	Battlement Mesa .....	797,720		
	Pikes Peak .....	847,968		
	White River .....	970,880		
	San Isabel .....	321,227		
	Gunnison .....	901,270		
	Leadville .....	1,219,947		
	Medicine Bow .....	1,155,909		
	San Juan .....	1,437,406		
	Park Range .....	757,116		
	Wet Mountains .....	239,621		
	Cochetopah .....	1,133,333		
	Montezuma .....	576,719		
	Uncompahgre .....	478,111		
	South Platte .....	654,499		
	Plum Creek .....	179,200		
Idaho .....	Weiser .....	324,964	734,556	
	Bear River .....		415,360	
	Bitter Root .....	3,860,960		
	Priest River .....	541,160		
	Pocatello .....	49,920		
	Yellowstone .....	177,960		
	Sawtooth .....	1,947,520		
	Henry's Lake .....	798,720		
	Payette .....	1,460,960		
	Cassia .....	326,160		
Kansas .....	Garden City .....		97,280	
Montana .....	Madison .....	770,000	188,800	
	Little Belt .....	501,000	82,560	
	Big Belt .....		630,260	
	Hell Gate .....		1,581,120	
	Gallatin .....	40,320	848,340	
	Helena .....		782,160	
	Yellowstone .....	1,229,680		
	Bitter Root .....	691,920		
	Lewis and Clark .....	4,670,720		
	Highwood Mountains .....	45,080		
Nebraska .....	Elkhorn .....	186,240		
	North Platte .....		347,170	
	Niobrara .....	123,779		
	Dismal River .....	85,123		
Nevada .....	Ruby Mountains .....		59,115	
New Mexico .....			423,660	
	Gila .....	2,327,040	496,860	

*Forest reserves, showing new reserves, additions, eliminations, etc.—Continued.*

State.	Reserve.	Area July 1, 1905.	Changes in area by procla- mations, July 1, 1905, to June 30, 1906.	
			New reserves and addi- tions.	Elimina- tions.
		<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
New Mexico.....	Portales.....		172,680	
	Lincoln.....	500,000	196,404	151,148
	Jemez.....		1,237,205	
	Pecos River.....	430,880		
Oklahoma.....	Wichita.....	57,120	3,680	
Oregon.....	Blue Mountains <sup>a</sup> .....	52,480	2,623,140	
	Bull Run.....	142,080		
	Cascade Range.....	4,424,440		
	Ashland.....	18,560	2,560	
	Wallowa.....	747,200		
	Wenaha.....	413,250		
	Chesnimnus.....	220,320		
	Maury Mountains.....	54,220		
South Dakota.....	Short Pine.....		19,040	160
	Black Hills.....	1,163,320		160
	Cave Hills.....	23,360		
	Slim Buttes.....	58,160		
Utah.....	Uinta.....	842,000	1,376,216	69,706
	Payson.....	111,600	55,680	
	Dixie.....		465,920	
	Sevier.....	357,000	353,920	
	Manti.....	584,640	193,280	
	Fish Lake.....	199,040	89,760	
	Beaver.....		261,593	
	La Sal.....		128,960	
	Vernon.....		68,800	
	Filmore.....		399,600	
	Bear River.....	182,080	85,840	
	Aquarius.....	639,000		
	Grantsville.....	68,960		
	Salt Lake.....	95,440		
Washington.....	Priest River.....	103,960		
	Mount Rainier.....	1,943,520		
	Olympic.....	1,466,880		
	Washington.....	3,952,840		
	Wenaha.....	318,400		
Wyoming.....	Uinta.....		63,632	59,036
	Yellowstone.....	6,580,920		
	Black Hills.....	46,440		
	Big Horn.....	1,151,680		
	Medicine Bow.....	418,759		
Alaska.....	Afognak.....	403,640		
	Alexander Archipelago.....	4,506,240		
Porto Rico.....	Luquillo.....	65,950		
Total.....		85,693,422	21,586,957	281,241

<sup>a</sup> Baker City with additions, now Blue Mountains.

On June 30, 1906, there were 82 officers in charge of 104,831,211 acres, leaving only 10 reserves, with an area of 2,168,212 acres, not yet under organized administration.

The field force on the reserves on July 1, 1905, consisted of 379 rangers, 87 guards, and 5 forest assistants (assigned as technical assistants to supervisors).

By June 30, 1906, the force was increased to 511 rangers, 247 guards, 18 forest assistants, and 30 laborers. On some of the reserves the volume of business made it necessary to give clerical assistance to the supervisor.

The important work of providing rangers with headquarters was pushed as rapidly as the funds available would permit, and in all 92 cabins were built at an average cost of \$53.

Good progress was made in building trails, which greatly simplified and improved the patrol of the reserves.

A decided advance was made in establishing and marking the boundaries of reserves, in cooperation with the United States Geological Survey. This work is essential to the discovery and prevention of trespass.

The damage done by forest fires has been greatly lessened. Approximately 279,000 acres were burned over—less than three-tenths of 1 per cent of the total area of the forest reserves.

On the passage of the act, on June 11, 1906, providing for the settlement of agricultural lands in the reserves, arrangements were immediately made for the examination, as provided in the law, of the lands applied for, by a corps of men especially qualified for the work.

The examination of lands for proposed reserves and additions to and eliminations from existing reserves has gone on rapidly. More than 30 million acres were examined during the year.

#### INSPECTION.

The work of the Section of Inspection during the past year aided greatly in increasing the effectiveness of the reserve force, both upon existing reserves and in organizing administration upon new reserves. Forty-one reserves already under administration were thoroughly inspected, and inspectors assisted greatly also in the organization of the reserve force upon 10 new reserves. The number of inspectors was increased during the year from 8 to 14.

#### ADMINISTRATION.

Under the new organization described above, the following reserve districts were established:

Northern District: Idaho, Montana, Wyoming, South Dakota, Minnesota.

Southern District: Utah, Colorado, New Mexico, Arizona, Nebraska, Kansas, Oklahoma.

Western District: Washington, Oregon, California, Alaska.

Of the 93 reserves in existence on July 1, 1905, 77, with a total area of 73,565,691 acres, were under administration, in charge of 54 supervisors or other officers. During the year 31,265,520 acres were placed under administration, with an increase of 28 officers in charge.

#### GRAZING ON THE RESERVES.

##### RANGE CONDITIONS.

The crop of forage on the forest reserves was better during the past season than for years before. Favorable climatic conditions resulted in an abundance of early feed, and the lamb crop was the largest reported for many years. Although some ranges have in the past been overstocked, the large amount of feed now on the ranges will probably make unnecessary any very great reductions next spring.

The abundance of feed outside of the reserves has, in some localities, lessened the demand for forest-reserve range, and has made the settlement of controversies in new reserves easier than it would otherwise have been. Yet in the old reserves the regular users applied for permits to graze about the same number of stock as the previous year.



The control of grazing has brought a marked improvement in range conditions on a number of the reserves, and there is no longer any doubt that a large part of the forage crop which was formerly wasted by improper handling of the stock is now saved and utilized.

Range conditions in general are very satisfactory, and the stockmen are enjoying a prosperity which gives them confidence in the future.

#### GRAZING FEES.

The announcement that a moderate charge would be made for grazing on the reserves after January 1, 1906, roused objection in some localities. Meetings were held and petitions were presented asking for modifications in the rates, and in a few cases for the entire remission of the fee.

By firm yet considerate action on the part of the Forest Service, and with the strong support of yourself and the President, all serious conflict was avoided. Stockmen realized the benefits of a proper system of range control, and have shown willingness to bear a just portion of the expense. When the regulations were modified better to meet existing conditions and a one-half rate was given to settlers for a limited number of cattle, all active opposition to the grazing fee ceased, and it has been paid almost everywhere without complaint.

The total amount received for fees on grazing permits during the year was \$514,086.74, of which about two-fifths was on account of permits for cattle and horses and three-fifths for sheep and goats.

#### PERMITS ISSUED.

The creation of 38 reserves available for grazing under regulation during the past season, and large additions to 14 of the old reserves, added greatly to the carrying capacity of the forest ranges. Slight increases in the number of stock were made in some of the older reserves, where the range conditions showed a marked improvement, and in others, after careful investigation, new areas were opened. In some of the newer reserves, where the range has been overstocked, reductions were made in the number allowed.

In the 92 reserves which were under administration before May 1 a total of 18,040 applications for grazing permits were approved by the forest officers in charge, and 16,593 permits were issued, as follows:

State or Territory	Cattle and horses.			Sheep and goats.	
	Number of permits.	Number of stock for summer season.	Number of stock for year-long season.	Number of permits.	Number of stock for summer season.
Arizona .....	581	30,096	67,718	87	347,208
California .....	1,979	132,256	20,529	190	403,683
Colorado .....	2,774	231,060	8,605	185	420,009
Idaho .....	385	29,053	531	182	878,550
Kansas .....	16	3,245			
Montana .....	1,373	93,514	6,862	79	249,908
Nebraska .....	62	26,806	405		
New Mexico .....	878	10,274	53,454	234	312,035
Oklahoma .....	37	384	2,153		
Oregon .....	915	75,656	1,242	352	1,124,539
South Dakota .....	433	13,041			
Utah .....	3,376	93,255	294	888	1,148,771
Washington .....	512	28,920	1,209	108	282,793
Wyoming .....	772	85,543	2,443	195	594,699
Total .....	14,093	849,703	165,445	2,500	5,762,200

The total number of sheep and goats includes about 3,000,000 lambs and kids, which in the issuance of permits have been counted as equal to 1,500,000 grown animals, leaving a net number of 4,262,200 grown sheep and goats covered by permit.

Only 1,447, or 8 per cent. of the applicants failed to pay the fees and accept the permits applied for, and many of these will make payment before the close of the season. The abundance of feed outside of the reserves was one cause of the failure to use permits.

In reserves established or put under administration after May 1, all stock on the reserve ranges at the time of their creation or whose owners had regularly used the range during previous years were allowed to graze without permit during the season of 1906.

#### CROSSING PERMITS.

Applications were made by 244 owners or lessees of private lands within 30 of the reserves for the privilege of driving a total of 18,823 head of cattle and horses and 118,438 head of sheep across reserve lands to reach 574,397 acres of private land. In 177 cases the owners of the land made special agreements waiving the right to the exclusive use of 387.930 acres of this land, and allowing all stock permitted to graze on the reserve to enter upon it. In exchange for this concession, permits were issued allowing the number of stock the private land would support to be grazed upon the reserve free of charge.

Under the regulation allowing stock to be driven across reserve lands in transit between summer and winter ranges and to reach points of shipment, 259 permits were issued by the officers in charge of 29 reserves for the crossing of 12,696 head of cattle and horses and 693,540 head of sheep.

No permit is required for stock which is driven along the public highway or when reserve lands will not be grazed upon en route.

#### QUARANTINE AND LIVE-STOCK LAWS.

The Bureau of Animal Industry has required all sheep permitted to graze upon the forest reserves of Arizona, New Mexico, Colorado, Utah, and Idaho to be inspected before entering the reserves, and to be dipped when they were found to have been exposed to or infested with scab. In South Dakota this inspection was made to include cattle, and all diseased stock were debarred from entering the reserves.

In most cases stockmen willingly complied with quarantine regulations and marked improvement in health of stock has followed. Continued enforcement of strict quarantine will entirely eradicate disease from the reserve ranges.

In several of the reserves the forest officers have rendered valuable assistance to the stockmen in the enforcement of local live-stock laws, particularly as to the grade and number of bulls turned upon the range and the prevention of loss by theft.

#### GRAZING TRESPASS.

There has been little trespass by grazing without permit. Except where the trespass was willful, settlement by the payment of reasonable damages has been accepted. When the trespass required exemplary action or when reasonable propositions of settlement were

rejected by the trespassers, the Department of Justice was asked to secure an injunction to prevent the stock from entering the reserve, and to bring suit for damages.

In a few of the new reserves, where the regulations were not understood or stockmen did not realize that they must be obeyed, stock which entered without permit was allowed to remain on payment of double the regular grazing fee. This method of settlement was received as fair and right. It has inflicted no serious hardship, while it has shown that the regulations must be obeyed and that forest reserve control means real protection to the range.

Occasionally stock trespassed upon closed areas or upon range to which it was not assigned. Where such trespass was willful the permit was canceled, a portion of the stock was removed from the reserve, and the amount paid for grazing fees was forfeited.

#### DEPREDACTIONS OF WILD ANIMALS.

The loss of cattle in Wyoming and southern New Mexico during recent years from wolves has caused much alarm. It was thought by many that the wolves were breeding in the reserves, and that the protection of game increased their number. In response to an appeal from stockmen, the Forest Service, in cooperation with the Biological Survey, is studying the habits of wolves and coyotes, the locations of their dens, and the most practical method for their extermination. It has already been found that the breeding grounds are not within the reserves, but in the foothills outside, and that they simply follow the cattle into the mountains during the summer. A large number of dens were located and steps were taken to kill both the old and the young wolves. It is confidently believed that the result of this investigation will be of great benefit to live stock interests.

#### LIVE STOCK ASSOCIATIONS.

Some of the live stock associations organized by western stockmen for the protection of their joint interests sought during the year official recognition of advisory boards to confer with forest officers on grazing matters. Much had already been done by the attendance of forest officers at the meetings of these associations to promote a right understanding of the purposes of forest reserves, and the benefits to be derived from their proper use. The justice of this request for recognition was seen at once, and authority for it was given by the Secretary of Agriculture on March 31, 1906. Before the end of the fiscal year, advisory boards of live stock associations in Oregon, Wyoming, and Colorado had sought and received official recognition. Through them, satisfactory solutions of local problems, which might have led to serious difficulty, have already been reached. A marked improvement in sentiment among stockmen has followed, and the cooperation of the live stock associations with the Forest Service to secure the very best use of the reserve ranges is made certain.

#### FOREST MEASUREMENTS.

##### FOREST COMPUTATION.

The broadened activity of the Forest Service has materially increased the scope of the work of the section of forest computation, which undertakes the computation and final statement of all forest



measurements. During the year this section worked up results for 7 working plans, 7 studies of commercial trees, 2 tallies of log products, 2 reconnaissances of planting sites, 5 pole, 2 tie, and 1 cross-arm seasoning experiments, and 13 miscellaneous projects. It included the computation of 5,517 valuation surveys, 27,700 tree analyses, 3,885 seedling analyses, 1,560 stump analyses, 13,156 height and 5,750 taper measurements, graded mill tallies of 14,300 logs, weights and measurements of 3,200 poles, 6,900 ties, and 10,800 cross-arms, and 18,700 reports from manufacturers and consumers of wood, as well as the compilation of figures for the number of live stock on the reserves from approximately 16,500 grazing permits.

## FOREST MAPS.

The section of forest maps is charged with the preparation of maps and drawings, and with the custody of those not needed for constant use. The work of the year included the completion of 1,128 maps, showing forest conditions of the forest reserves and of areas proposed for forest reserves, and illustrating working plans, planting plans, the distribution of trees and forests, the progress of logging, and many other subjects. Two hundred and one drawings were made, illustrative of methods, appliances, experiments, and results in many branches of forest work. One thousand seven hundred and sixty maps were mounted and 2,408 maps supplied to the field from outside sources.

## FOREST MANAGEMENT.

## TIMBER SALES.

In accordance with the policy which aims to satisfy every legitimate demand for the use of the forest reserves, more than five times as much timber was sold during the past fiscal year as during the previous one. The following table shows for each State the amount and value of the timber sold:

*Timber sold from July 1, 1905, to June 30, 1906.*

State or Territory.	Feet B. M.	Cords.	Linear feet.	Posts and poles.	Value.
Alaska.....	2 252,616	1,132	43,229	.....	\$1,423 80
Arizona.....	27,596,349	5,977	.....	1,200	70 126.28
California.....	10,302,282	430	.....	57,600	13,170.57
Colorado.....	27,281,329	19,900	.....	29,913	38,531.84
Idaho.....	8,858,102	2,123	.....	16,407	13,381.50
Montana.....	53,512,895	7,072	61,012	151,119	109,560.94
New Mexico.....	1,024,356	8,321	38,921	7,110	3,761.10
Oklahoma.....	.....	3	.....	100	12.00
Oregon.....	438,500	291	80,000	100	710.85
South Dakota.....	72,951,730	29,328	.....	42,450	85,265.87
Utah.....	10,677,484	2,025	.....	1,100	14,715.55
Washington.....	1,989,500	1,997	.....	2,100	2,877.50
Wyoming.....	71,255,683	1,580	.....	3,850	147,408.16
Total.....	288,140,826	80,179	223,162	313,049	500,945.76

The time allowed for cutting was from one to five years, and much of the timber sold has not yet been cut. Receipts for timber actually cut and removed amounted to \$242,668.23.

In every case the cutting of live timber under sale, or for free use, was allowed only after careful study on the ground which showed that the timber applied for could be cut without injury to the forest or the water supply, and indicated the best method of cutting to insure another growth of timber and safeguard the permanent forest cover. Applications for the purchase of reserve timber called for detailed examinations during the year of over 100,000 acres.

Only trees marked for removal by the forest officers were allowed to be cut. Contracts for the sale of timber stipulate that all brush and debris caused by logging shall be piled in openings for burning, and other precautions are taken to protect the forest from fires during logging. Complete utilization of all merchantable parts of the trees is enforced by requiring the cutting of low stumps, the sawing of logs well into the tops, and the use of all material of value for any purpose. Forms of waste such as the use of thrifty trees for skid-poles and corduroy and the destruction of promising young growth by careless felling are prevented by close supervision. Payment for timber sold is always required on the basis of the actual scale, and scaling is always done by the forest officers.

Small sales greatly outnumbered large sales. Over 100 sales each of less than 5,000,000 feet were made for every sale of more than that amount. A marked improvement took place in the prompt consideration of applications for the purchase of timber, especially in small amounts.

The largest sales were made in the lodgepole pine forest of the Rocky Mountains in Wyoming and Montana. Lodgepole pine occurs at high altitudes and in inaccessible locations, and is very largely within the forest reserves. The success with which it is being treated chemically has created a great demand for lodgepole pine ties by the railroads in the Northwest. This demand and the increased value of timber of every description has made a strong market for this tree, which but recently was considered valueless and in many localities is still so regarded. The prices of lodgepole stumpage ranged from \$2 to \$5 per thousand feet.

Encouraging progress was made during the year in disposing of dead and beetle-infested timber on the Black Hills Forest Reserve in South Dakota. Sales were made to the amount of 73,000,000 board feet, for which over \$35,000 will be realized. The only way to control the beetle is to cut the infested trees while the insects are still in them. A special effort is being made to sell, before it decays, the large amount of timber which has already been killed.

In Colorado and Utah sales were largely confined to fire-killed timber, of which there are vast amounts in the mineral districts. The demand for dead timber comes largely from the mines, and from operators of small sawmills, which supply towns and ranches located away from the railroads.

In Arizona and New Mexico, timber was mostly sold in small quantities to mines and small mills. Twenty-five million board feet were sold at from \$2.50 to \$3 stumpage on the San Francisco Mountains Forest Reserve, where a very large amount of mature timber, within easy reach of railroad transportation, can be cut without injury to the forest.

In the Pacific Coast States the demand for timber has been supplied almost entirely from forests in the hands of private owners, and sales from the reserves were small.

## WORKING PLANS.

The Forest Service prepares detailed working plans for the conservative use of the forest reserves as rapidly as its funds permit and trained men are available for the work. But the area for which working plans can be prepared at present is small. Every timber sale entails a careful advance examination, including an estimate of the timber, the preparation of a forest map, a description of the forest, and regulations for the conduct of the logging. So urgent and so widely scattered is the demand for timber that the resources of the Service have been absorbed in caring for these sales, and few independent working plans have been attempted.

The preparation of a working plan was begun for a large portion of the Henrys Lake Forest Reserve, in Idaho. The forest contains a very limited supply of mature timber, which is in great demand for the development of a rapidly growing agricultural community.

## TIMBER TRESPASS.

Of the total of \$242,668.23 received during the year from timber, \$39,334.96 was collected in settlement for timber trespass. This sum was in settlement chiefly of trespass on public lands afterwards thrown into reserves. As soon as a reserve is created and placed under administration, timber trespass practically ceases.

## INSPECTION.

Systematic inspection of timber sales by a corps of special inspectors was organized early in the year. The forest reserves were divided into districts and an inspector held responsible for the standard of the work in his district. Assistance and advice is given the local forest officers in initiating new sales and in the technical conduct of the cutting under current sales and free use. Inspectors report regularly to the Washington office the condition of timber-sale operations on the reserves within their districts.

## COOPERATION WITH PRIVATE OWNERS.

During the past year, 99 applications were received for advice and assistance in the management of small woodlots, comprising an area of 8,058 acres, and 61 from owners of timber tracts covering an area of 761,965 acres. These applications came from 30 States and Territories. The total area of private forest lands, in the management of which assistance has been asked, since the publication of Circular 21, is 11,717,269 acres, of which 37,326 acres is in woodlots.

During the past year examinations were made of 54 timber tracts, in 26 States, covering a total of 2,076,085 acres. Detailed working plans were recommended and begun on 11 of these tracts; on the others final reports could be and were prepared with recommendations for the conservative management and protection of the forest without making special working plans. This was a result of the knowledge of forest conditions throughout the country gathered by past work. On many of the tracts the recommendations have been already put into effect.



## WOODLOTS.

Working plans based on a thorough examination on the ground were prepared for 100 woodlots, with a total area of 7,104 acres located in 16 States. The object of this work is to give free of cost to farmers and other small owners advice and assistance in the use and improvement of their woodlands. During the past year particular study was given to woodlots in southern Michigan, Ohio, and Indiana, in continuation of the work begun the previous year. The woodlots of this region present very different problems from those of the Atlantic States. The object was to collect information enough for a publication on the problems and methods of treatment for woodlots in the Middle West.

Inspection in New England was made to ascertain whether the recommendations of previous working plans have been carried out. It was found that they had been either in whole or in part, particularly for recent plans and where trees were actually marked for thinning. Woodlot working plans are no longer made without marking trees for thinning on sample areas.

## WORKING PLANS FOR TIMBER TRACTS.

In New York three working plans were prepared, two for small tracts belonging to country estates, which yielded knowledge of the rate of growth of second-growth hardwoods, and one for a tract of 100,000 acres in the northern part of the State, which included a scheme of fire protection and a plan to correct the previous wasteful logging and lax supervision. In Michigan a working plan for a tract of 8,000 acres, maintained in connection with a summer resort, provided, by a system of selection cutting and of planting on unstocked sandy areas, for a fair profit from the sale of timber combined with improved condition and appearance of the forest. A plan for a tract of virgin hardwoods on coal lands in the Southern Appalachians, in Kentucky and Virginia, provided for maintaining a supply of mining timbers, for marketing for other uses the mature timber of valuable kinds, and for reproduction of the best species after lumbering; also for planting open areas with trees which will produce valuable lumber, such as black walnut and yellow poplar, and mine props; and it indicated simple but effective methods of protection against damage from grazing and fire. Lastly, on a tract of 27,000 acres made up of small holdings of mixed pine forest in South Carolina, already heavily cut over, a study of the present and future values showed that in most cases it would pay to hold the timber rather than to cut it now.

A combined fire-protection and working plan was put into operation upon a large tract in California. It aimed to prevent fires from starting by means of patrol along a carefully laid out route. Telephone and tool stations were located to strengthen the patrol. To check fires once started and furnish bases for back firing, broad fire lines on which the slash was burned were run through the cut-over lands. The cost of all this was about 2 cents per acre per annum.

Experiments were also made in slash burning. The character of the logging made it possible to burn the slash without piling, at a cost of only  $1\frac{1}{2}$  cents per thousand feet of timber logged. The plan was so successful in operation that it has been extended to all the

holdings of the company for which it was prepared. Virgin timber on the tract was marked for removal. A diameter limit of 30 inches left enough trees standing to insure a second cut.

#### STATE COOPERATIVE STUDIES.

Cooperation was carried on during the year with California, New Hampshire, and North Carolina.

The work in California included a commercial-tree study of white fir, a market study of the chief commercial trees, and an estimate of the North Calaveras grove of big trees. The latter was a careful estimate of the standing timber, both of sequoia and other species, on 640 acres including and surrounding the North grove.

A white-fir study in California was begun as part of a larger study undertaken by the Forest Service, in cooperation with the State, to ascertain the present uses and possible new uses of this tree. Though not at present of great commercial value, the white fir is so abundant that to find better uses for it will greatly simplify the management of the Sierra forests. The work included a careful study of the silvics of the tree, its growth in height, diameter, and volume, its present uses, and methods for managing it on areas where it is the sole or the prevailing species. Its mechanical and physical properties will next be studied, and the possible use of the timber for pulpwood and other purposes will be determined.

A market study in California covered the most important commercial trees of the Sierras. The cost of logging, milling, and transportation in typical forest regions throughout the State were determined, the value of forest land and the cost of protection and taxes were studied, and the average cost of manufacture and the prices obtained for manufacturing lumber at important distributing points were ascertained. The results of the investigation are being prepared for publication in cooperation with the State.

In cooperation with New Hampshire a study of the forest conditions of the southern part of the State was begun. Maps were prepared showing the distribution and the composition of the forests, the percentage of forest and cleared area, and the distribution of the chief species. The study will include:

- (1) A study of the silvical characteristics of all the forest trees.
- (2) Volume tables, in cords and in board feet, for trees of all diameters and heights for all the commercially important species.
- (3) Yield tables for second-growth white pine, showing the best-paying period for cutting.
- (4) Methods of management best adapted to different conditions, based on a study of present methods of lumbering.
- (5) Suggestions for a State policy for fire, taxes, and the encouragement of practical forestry.
- (6) A mill-scale study, showing the actual amount and grades of lumber sawed from chestnut and white pine of different diameters.

The swamp lands belonging to the State of North Carolina were carefully examined at the request of the State, to determine the advisability of selling the timber under restrictions and holding the land. The examinations showed that it would be much better to sell the timber alone, and that by cutting to a diameter limit future crops of timber would be produced within reasonable time.

## OTHER STUDIES.

At the request of the Office of Indian Affairs, through the Secretary of the Interior, the Forest Service supervised the logging on the Wisconsin Indian Reservation. Under the direction of an agent of the Forest Service seed trees were marked on over 4,000 acres, and the slash was piled for burning and the ground cleaned up along the logging railway on all land cut over during the season.

At the request of the Secretary of War an examination was made of the timber on the Fort Wingate Military Reservation in New Mexico. The examination showed the amount of merchantable timber, chiefly western yellow pine, on the reservation and the amount which should be cut, and recommended rules for the sale and logging of the mature and overmature timber on over 23,000 acres.

The object of a tie-production study, undertaken in cooperation with the Northern Pacific Railroad, was to determine the present supply of tie timber in northwestern Wisconsin and northern Minnesota, and discover what practical steps can be taken to provide for a future supply. The investigation showed that the present supply of tie timber is limited, but that the character of the timberlands available will not at present warrant purchasing standing timber and managing it for a continued supply. Norway pine, both in rate of growth and value as a tie tree, under practical management, was shown to be the best tree for planting. It will produce ties in from fifty to sixty years, at a cost of 12 to 18 cents per tie, by planting it 8 by 8 feet on the rolling, sandy pine soils, which are unsuited to agriculture.

In cooperation with the Hydrographic Division of the United States Geological Survey the extent and character of the forested areas at the headwaters of the chief tributaries of the Potomac River and their influence on the water supply were studied. It was found that most of these streams head in well-wooded regions, where the forest conditions are satisfactory, the water flows fairly regular, and the water itself pure. The muddiness and other impurities of the Potomac water come almost entirely from the lower courses of its tributaries, where a large percentage of the area is tilled land, and from the towns along the Potomac itself. The present objections to Potomac water will increase as the watershed is further settled and developed. Forest reserves about the headwaters of certain important tributaries and the use of the water directly from the points where it is abundant and still pure are the most practical means of solving the present difficulty.

In cooperation with the Bureaus of Chemistry and Entomology a study was made in the vicinity of Ducktown, Tenn., to determine the character and extent of damage upon the forest from the sulphur fumes produced in smelting copper. It was shown beyond a doubt that fumes from the smelters were doing great and increasing damage to vegetation.

## WORK FOR THE ENSUING YEAR.

## TIMBER SALES.

During the coming year the timber-sale work will be carried on along the same lines as in the past year, particular attention being given to the adjustment of prices for lumber.



Plans for disposing of timber infested by the Black-Hills beetle on the Black Hills Forest Reserve in South Dakota, already under way, will be carried out. Particular attention will be given to stopping the spread of this insect, in accordance with recommendations made by the Bureau of Entomology. In Colorado, also, where this beetle has appeared, steps will be taken to remove the insect-infested trees before the beetles can spread to green timber.

The sale of dead timber on the reserves will be pushed, and where possible it will be sold rather than green timber. Sales of mature green timber, however, will be encouraged where the timber can be removed without injury to the interests of the reserves.

#### COOPERATIVE.

During the coming year cooperation will be carried on with the agricultural experiment station of the State of Ohio, with a view to determining the best management of small timber tracts and the most profitable disposal of timber by small woodland owners.

Work will be carried on in cooperation with the Indiana State Experiment Station, and will be completed early in the year. The results will be of great value in the management of woodlots throughout the State.

Among others, a working plan will be prepared for a tract of 65,000 acres in Arkansas. The chief object will be to outline a plan for the continued cutting of timber and efficient protection from fire.

Inspection and assistance will also be given in the States where working plans prepared by the Forest Service are being carried out by the owners. This work has great value.

Examinations of woodlots and assistance to timberland owners will be continued as in the past.

#### FOREST EXTENSION.

The urgent need for the reforestation of denuded forest reserve watersheds and of the treeless reserves in the Middle West and the increasing realization that timber growing is profitable have greatly broadened the field of forest planting during the past year. The planting work of the Forest Service embraces, first, extensive nursery and planting operations on the National forest reserves, and, second, cooperative assistance to landowners. The organization of the work is unchanged, except that in March the section of forest replacement was consolidated with reserve planting.

#### RESERVE PLANTING.

Great impetus was given to forest reserve planting by the transfer of the reserves to the Forest Service. But since most of the nurseries are new, extensive field planting has not yet been possible, and seedling production was the main work. About 493,000 trees were planted this year, and over 3,000,000 are now in the nurseries, of which at least 1,500,000 will be large enough to set out next season. Seed enough to produce 6,000,000 seedlings was planted in nursery beds last spring. The six nurseries now comprize a total of 13.15 acres, of which about 8 acres are in seed beds and the remainder is used for

transplants. The annual productive capacity of the Forest Service nurseries at present is approximately 8,000,000 trees.

The cost of the several items of nursery and planting work is encouragingly low. Except at the California stations, where the difficulties are great, the expense of growing and planting does not greatly exceed that in Germany, with its cheap labor and long experience. The average cost per thousand of the 1-year-old seedlings now in seed beds outside California is \$0.81. Transplanting from seed beds to nursery rows costs an average of \$1.04 per thousand, while seed sowing costs 15 cents per pound. Field planting in the reserves of southern California is very expensive as yet, because of the natural difficulties. The average cost per thousand of setting 62,000 trees on chaparral-covered watersheds in the Santa Barbara and San Gabriel forest reserves was \$17.22; while on the Dismal River Reserve, where conditions favored rapid work, 319,000 trees were planted at a cost of \$1.63 per thousand.

The progress of the year's work at each of the planting stations may be briefly indicated.

#### SAN GABRIEL FOREST RESERVE (HENNINGER'S FLAT STATION).

The working equipment was increased by the erection of a combination tool house and sleeping quarters for laborers, and by enlarging the transplant nursery 0.75 acre. The lath house, which covers approximately 0.27 acre of seed beds, was worked to its full capacity. The 336,760 seedlings it contained were transplanted to open-nursery rows during the winter, and in the spring the beds were resown with about 222 pounds of seed of 11 species. The nursery rows now contain about 387,000 trees.

During January and February 32,000 two-year-old trees were set out in the mountains. The blanks in previous plantations were filled in and small experimental plantations were made at intervals of 500 feet in altitude up to the summit of Mount Wilson. One new site was planted and an arboretum of 3,500 trees was established. The nursery and planting sites are protected by 12 miles of fire lines, built in 1905. Planting in the San Gabriel Reserve must remain a difficult and expensive operation, yet the cost was reduced to \$15.92 per thousand trees, a reduction of \$29.34 over last year.

Approximately 30 per cent of the trees set out this year have been eaten off by rabbits and a remedy applicable on a large scale has not been found. A careful study of the situation has been asked of the Biological Survey.

Besides furnishing plant material for local use, the Henninger's Flat nursery supplied 30,000 trees for planting in the Santa Barbara Reserve, 3,100 for Griffith Park, Los Angeles, and 11,900 for planting by individuals on watersheds within forest reserves or for experimental purposes.

#### DISMAL RIVER FOREST RESERVE (HALSEY STATION).

The Halsey station is producing trees for extensive forest planting on nonagricultural lands in the Middle West. An additional acre of lath house was built, about 0.5 acre was set out to transplants, and 1.5 acres of open seed beds were sown with broadleaf species. The nurs-

ery now covers 5.5 acres, with 3.5 acres under lath, contains 1,680,000 trees, nearly two-thirds of which will be ready to set in the field next year, and has an annual productive capacity of about 3,000,000 trees. About 540 pounds of seed were sown during May and early June. A hand seed drill reduced the cost of sowing to 5 cents per pound.

Field planting was somewhat curtailed to allow the nursery stock to attain larger size. Previous losses were largely due to the use of too small plant material, and in the future only selected stock 2 or 3 years old will be planted. About 319,000 two-year old seedlings, 93 per cent of which were western yellow pine, were set out.

A total of 154,000 trees was shipped from Halsey for planting elsewhere, including 30,000 sent to Helena, Mont., for use in Helena Forest Park, and 50,000 furnished to the Reclamation Service for planting along the interstate canal in Wyoming and Nebraska.

#### PIKES PEAK FOREST RESERVE (CLYDE AND BEAR CREEK STATIONS).

The Rosemont nursery site, established in 1904, will be abandoned, leaving Clyde and Bear Creek as permanent stations. At the Clyde nursery the half acre under lath contained about 410,000 seedlings when spring opened. Since seed sowing in 1905 was delayed until July, awaiting the completion of the lath house and water system, the seedlings were too young to withstand well the severe winter. The beds which failed wholly or in part were resown.

To secure a lower elevation and a longer growing season, an additional half acre of seed beds on a 1.8-acre nursery site was prepared and sown in Bear Creek Canyon, and a water system was installed.

Since the seedlings in the Clyde nursery were not old enough to set in the mountains, 20,000 red fir seedlings were shipped from the Halsey nursery. They were planted in two sites under good weather conditions, and promise to grow with slight loss.

Although the high elevation and rough slopes in the Pikes Peak Forest Reserve make difficult conditions, there is every indication of ultimate success. Several important watersheds need planting, and the work is supported by public sentiment.

#### SANTA BARBARA FOREST RESERVE (SAN MARCOS STATION).

The nursery, which was established in San Marcos Pass in the spring of 1905, contains 181,000 one-year-old seedlings in transplant beds. The 5,760 square feet of beds under lath from which the transplants were removed were resown with 127 pounds of seed, mainly knobcone, Jeffrey, and gray pine.

The first field planting in this reserve was done this year, with 30,000 two-year-old seedlings from the Henninger's Flat nursery. The sites selected were at elevations varying from 1,400 to 3,500 feet. Two and one-half months after the trees were planted over 95 per cent were in good condition.

#### GILA FOREST RESERVE (FORT BAYARD STATION).

The half acre of seed beds sown in July, 1905, produced about 385,000 seedlings, 300,000 of which were transplanted to nursery rows. The beds were resown this spring with 15 species, to give a thorough test of southern California conifers and of native trees.



The work at the Fort Bayard station aims to reforest 7,000 acres in the military reservation, as well as to improve reserve catchment basins. The War Department, in December, 1905, granted the use of 275 acres in the northern part of the reservation, on which a transplant nursery of 1.4 acres has been prepared and an adobe station building is under erection.

None of the seedlings in the local nursery were large enough to be set out this year, but 425 conifers were shipped in and field sowing was tried with Mexican walnut and three native oaks on 48 plats, aggregating 13.4 acres.

#### SALT LAKE FOREST RESERVE (WASATCH STATION).

This station was established last spring in Big Cottonwood Canyon, near large areas in urgent need of reforestation. The nursery site contains about 4 acres, one-half acre of which was covered with a lath house and devoted to seed beds. Good planting sites and the high value of water in Cottonwood Creek make forest planting on this catchment basin promising and important.

#### GARDEN CITY FOREST RESERVE.

In May 51,000 western yellow pine from the Halsey nursery, and 40,000 red cedar, Osage orange, Russian mulberry, and honey locust, purchased from dealers, were planted in four strips across one quarter section. Experiments to learn whether cultivation is necessary will be carried on during the summer.

#### BLACK HILLS FOREST RESERVE.

In the Custer Peak region the experimental broadcast sowing of western yellow-pine seed in May, 1905, had produced in October an average stand of about 12,000 seedlings per acre. Last spring an additional 500 pounds was sown in the same region, part on the late melting snows and part on the bare ground immediately after the snow had melted. If continued success follows this work it will be possible to reforest the denuded portions of the Black Hills Forest Reserve rapidly and at a very low cost.

#### WICHITA GAME RESERVE.

The first planting in this reserve was undertaken this spring on an experimental scale, with 1,000 western yellow-pine seedlings from the Halsey nursery. A report from the supervisor, late in May, stated that every one was growing.

#### SEED COLLECTING.

Most of the seed needed in the various nurseries was collected locally. For the Halsey station it was necessary to collect jack pine in Minnesota and western yellow pine in the Black Hills and western Nebraska.

Over 4,500 pounds of seed was on hand at the planting stations on January 1, part of which was collected in 1903 and 1904. Of the 15 species represented, about 2,200 pounds was yellow pine, gathered at a cost of only 33 cents per pound.

Since most of the trees used in reserve planting bear full seed crops only at intervals of from two to seven years, surplus seed must be stored. Storage tests to determine how best to preserve the germinative energy were begun at five of the stations and at Washington.

A series of tests on the vitality, germinative energy, weight, volume, and purity of 27 species of pine seeds was carried on in cooperation with the Seed Testing Laboratory of the Department.

#### RECONNAISSANCE.

Extensive preliminary examinations for reserve planting plans were finished during the year in the Lewis and Clark, Modoc and Warner mountains, Cassia, Malad, Salt Lake, Gunnison, and Gila forest reserves. Favorable openings were found in the Salt Lake Reserve, where a nursery has since been established; in the Malad Division of the Bear River Forest Reserve, and in the Gila Forest Reserve.

Planting for the improvement of city watersheds located within forest reserves is an urgent duty of the Forest Service. A preliminary reconnaissance was made on reserves in the Southwest, and examinations were completed of the water systems of Pueblo, Colorado Springs, Denver, Boulder, Longmont, Loveland, Fort Collins, and Greeley, Colo.

#### OFFICE WORK.

A plan was devised and adopted for indexing in condensed form the data on nursery work and planting for each reserve. The essential data of former planting station reports were transferred to cards indexed under subjects and years.

#### COOPERATIVE PLANTING.

The cooperative work was continued under the general provisions of a revised edition of Circular 22. An entirely new outline for planting-plan studies and reports was adopted.

As a rule planting plans were made without charge for small land-owners, public and educational institutions, and Departments of the Federal Government. For large private holdings the preliminary examination was made free, but the field expenses of the detail plan was charged to the cooperator, as was the cost of supervising the execution of the plans.

A set of index cards was compiled giving data on 1,325 forest plantations in 26 States, and another giving notes on seed production, seed preservation, germination percentage, methods of propagation, etc., for 72 species. Incomplete data on 49 additional species are also filed.

#### PLANTING PLANS.

During the fiscal year there were made 33 detailed plans for planting on 10,233 acres in 19 States, 5 preliminary examinations, covering 103,895 acres, where planting was not recommended, and 6 examinations, covering 212,660 acres, where planting plans were advised, but action is still pending. In North Carolina a plan for fire protection was prepared for a tract of 1,200 acres. There are 34 applications now on file for lands aggregating 13,711 acres.

The request made for supervision of nursery and planting operations show that the planting plans are being carried into execution. Such work was done this spring for 11 cooperators, including the Reclamation Service, two coal and coke companies, two railroads, two cities, and a city water company.

Cooperative funds to the amount of \$2,267.50 were received during the year from 17 landowners for use in preparing planting plans or supervising their execution.

#### PRESENT STATUS OF COOPERATIVE PLANTING.

During the past year large landowners, especially railroads and coal companies, have shown a marked tendency to undertake forest planting on a commercial basis. Their motives are purely economic and arise from the increasing difficulty of getting ties and construction timbers, even at high prices, and from a desire to utilize and improve their lands.

At least 11 railroad companies are directly interested in procuring a future wood supply and have actually begun forest work. Examinations were made of 18 railroad plantations in Virginia, Kentucky, Illinois, Indiana, Michigan, and Pennsylvania, and of a tract in Virginia on which planting was contemplated. For the Illinois Central Railroad a planting plan was made for lands in Iowa, and improvement cuttings in their catalpa plantations in Louisiana and Illinois were supervised. The Union Pacific Railroad entered into an agreement and provided funds for an examination of certain of their holdings to learn the advisability of forest planting for tie production. The Pennsylvania Railroad paid the cost of an investigation to lay down a future forest policy, which will insure a permanent tie supply for their lines east of Pittsburg. This work included a study of their present holdings and the preparation of a planting plan for various tracts in Pennsylvania. The Baltimore and Ohio, Santa Fe, and New York Central railroads will take up forest planting in the near future, and an application is on file from the Long Island Railroad for an examination of its waste lands.

Planting plans made for two coal and coke companies in western Pennsylvania last summer were carried into execution under Service supervision this spring. The field work for a planting plan on a 36,000-acre watershed in eastern Pennsylvania, owned by a coal company, was started in June. Another large eastern coal company is expected to apply for assistance in planting their waste lands as the result of a preliminary examination in November. The report made after the examination was published in full by the company.

For the improvement of city watersheds cooperative assistance was rendered to the Johnstown Water Company, in Pennsylvania, and to the Bridgeport Hydraulic Company and East Hartford Fire District in Connecticut. In southern California plans were prepared for planting four tracts where watershed improvement was one of the prime objects. The plans for city forest parks for Helena, Mont., and Los Angeles, Cal., were carried into effect under the direction of the Service.

Increased assistance was given to other branches of the Federal Government. Planting plans were made during the year for portions of the Fort Bayard, Fort Riley, and Fort Stanton military reserva-



tions, together with an examination of the reservations around San Francisco to learn the advisability of planting. In Vermont a planting plan was prepared for lands around a station of the Bureau of Fisheries. For the Reclamation Service recommendations were made for planting along the interstate canal in Wyoming and Nebraska, and around the reservoir and along the canals of the Salt River project, Arizona. Planting along the interstate canal was begun in May with 50,000 trees from the Halsey nursery.

To aid settlers in newly irrigated regions, forest-planting investigations were started in the North Platte and Truckee-Carson projects. These studies will also cover the questions of planting for the protection of Government canals and on waste lands. In North Dakota recommendations for handling certain timberlands on the Buford, Trenton, Williston, and Nesson irrigation projects were prepared for the State engineer.

Farmers have been given all possible assistance. Planting plans were made as formerly, and much effective work was done through lectures at farmers' institutes. A lecture at Amarillo, Tex., was followed by the formation of a tree-planting association with about 600 members, who have already set out about 200,000 trees, under advice from the Service, and will set out many more.

#### SPECIAL INVESTIGATIONS:

The possibilities of forest planting on coal lands were studied in the upper Ohio Basin, with special reference to black locust and the danger of damage by borers. Such planting promises to be profitable, but the use of locust was found unsafe unless the trees are cut for posts when small, or methods are found and applied which will insure control of the insect pest.

A study of planted and natural timber in Iowa was finished.

The following investigations were a part of the State cooperative work in California:

(1) Study of forest planting in agricultural regions. The nearly completed work will cover the field of forest planting for protection and wood supply in the agricultural valleys.

(2) The relation of forest cover to stream flow. The importance of water for power and irrigation in California led to this investigation, in which many valuable observations were made.

(3) Study of State lands. This work was entirely completed during the year. The report, as submitted to the California State Board of Forestry, gives information on the location and extent of the State forest lands, with recommendations for legislative action.

(4) Study of the silvical characteristics and methods of propagation of eucalyptus. This was undertaken because of the newly appreciated value of eucalyptus for posts, telephone poles, piling, and ties.

#### COOPERATIVE EXPERIMENTAL PLANTING.

In various regions more exact knowledge is needed as to the effect upon species of soil and climate, the adaptability of new species to planting, and the best silvicultural methods. To secure this the Forest Service will carry on systematic experiments in cooperation with various colleges and State forest commissions. The cooperators in all cases furnish the land free and the expenses for plant material and labor are divided equally. This work is now under way in

cooperation with Berea College, Kentucky, the New York Forest, Fish, and Game Commission, the University of Michigan, the Michigan Forestry Association, the Iowa State Agricultural College, the University of Nebraska, the North Dakota Agricultural College, and the Mississippi Agricultural College.

#### PLANTING LEAFLETS AND ADDRESSES.

The planting leaflets for use in correspondence now number 36 for single species and 12 on general subjects, such as how to transplant forest trees, fence-post timbers, etc. The mimeographed sheets giving lists of dealers and range of prices for plant material, which are used as supplements to the leaflets, were brought up to date. The total number now available is 41.

Information on farm forestry was disseminated in the West by means of farmers' institute lectures. A Forest Service representative accompanied institute parties on extensive trips through eastern and western Colorado and parts of Nebraska. Lectures were also delivered before various farmers' meetings in Iowa, Texas, and Mississippi. Addresses on special forest topics were given at public meetings in Illinois, North Carolina, Georgia, Maryland, Vermont, Kansas, Colorado, New Mexico, and California. At the Iowa State Agricultural College, the University of Nebraska, and the Mississippi Agricultural College, technical Service men are furloughed during the winter to give instruction in forestry.

#### WORK FOR THE ENSUING YEAR.

##### COOPERATIVE PLANTING.

The preparation of planting plans will be continued under a somewhat revised plan. Small landowners, public and educational institutions, and branches of the Federal Government will be given gratuitous or cooperative aid as in the past. Corporations and large landowners, however, will be called upon to pay all the expenses, unless the work is of high educational value. It will be the aim to get in closer touch with the farm through farmers' associations and farmers' institutes. Special investigations will be limited to fields where immediate practical results will accrue. The most important work of this kind under way is a forest-planting reconnaissance in reclamation projects. Other important tasks are the improvement of city watersheds in the East and an investigation of artificial methods of timber propagation in the South.

Experimental planting will be continued in cooperation with State forest commissions and colleges, and begun on the areas withdrawn for this purpose within reclamation projects.

##### RESERVE PLANTING.

The present reserve planting stations will be made more permanent by the erection of suitable station houses, and the productive capacity of the nurseries will be increased where advisable. New stations will be established as required, and small nurseries under the charge of the reserve officers will be started wherever plant material is needed for local use. The investigation of city watersheds within forest

reserves should lead to several new nurseries and to extensive planting by the rangers under technical supervision. The new plantations will demand complete fire protection, which will be planned for by technical men and executed by the reserve officers.

Planting on all the treeless reserves in the Middle West should be started next spring with plant material from the Halsey nursery. The Niobrara, North Platte, and Portales reserves need large experimental plantations to determine whether local nurseries are called for. In the Black Hills Forest Reserve broadcast sowing will be conducted on a larger scale if it continues to give promising results. A large quantity of tree seed for use at the planting stations will be collected again this fall.

### DENDROLOGY.

A large correspondence is entailed by requests for technical information, especially as to the distinguishing characters of tree species, native and foreign, and their economic products. Many identifications of wood, seed, and other specimens of native and foreign trees are called for by individuals and educational institutions, and especially by builders, architects, and engineers, in consequence of the frequent substitution on the market of inferior woods for standard building materials. In all, 3,366 letters were prepared on dendrology.

### TURPENTINE INVESTIGATIONS.

Experiments were continued during the turpentine season of 1905 to discover the effects of different methods of chipping on the yield and on the life of the trees. Final results in such experiments require data for several years, but the indications are that by chipping a "streak" half as deep and half as high as in the present practice an equal or greater yield of turpentine per year can be obtained, and the working period can be doubled.

Experiments to compare the results of the present method of working and one under which only trees over 10 inches in diameter are chipped with fewer "faces" showed that over 20 per cent more turpentine was obtained from the latter method. If these results are confirmed they will lead to a radical change of method, under which a tract may be worked indefinitely. At present turpentinizing lasts for but three or four years and virtually destroys the forest.

A chemical study of the distinguishing characteristics of turpentines from different species of pines was begun in cooperation with the University of North Carolina. Commercial turpentine is distilled without distinction from the resins of longleaf, Cuban, shortleaf, loblolly, and pond pines, though mainly from the first two. The products of these several species differ chemically and otherwise, which doubtless explains past failures to find a method for detecting adulterated spirits. The study will throw light on this matter, but is expected to be chiefly valuable by showing which of the species now worked (and possibly, also, new species) yield turpentine in paying quantities, and which yields the most. This is important in forest management, to determine which species should



be favored in the future forest. Already it has been shown that loblolly and shortleaf, believed by many operators not to yield turpentine, equal the yield of longleaf. The experiments include tests, also, of the resins of Virginia ("scrub") and western yellow pine.

#### FOREST DISTRIBUTION AND RESOURCES.

Studies of the forests of five Maryland counties, in cooperation with the State geological survey, were completed and will be published by the survey. The study of one other county is in progress. A silvical study of the "Big Thicket" region of south-central Texas was completed, and one of the brown-wooded cedar forests of Texas is under way. Information was furnished the Canadian geological survey as to the range in the United States of commercially important Canadian trees. A report on the identification and uses of American woods was prepared.

#### BASKET WILLOWS.

The basket-willow holts now contain 25,000 vigorous stools. Some 200,000 green rods were cut from them in February and yielded 1,400 pounds of basket stock as good as the finest imported rods, together with 5,000 choice cuttings for extending the plantation, and 12,000 for free distribution.

Manufacturers have studied the methods by which rods equal to the best imported stock were grown at home, and in some cases are preparing to establish holts of their own, while numbers of small producers have been led to enter the field of willow production.

Samples of bark from the different varieties of willow under experiment were analyzed for the Forest Service by the Bureau of Chemistry, and it was found that the purple and almond willows yield 8.73 and 11.39 per cent of tannin, respectively, or about the same as the standard tanbark oaks. Other willow barks gave results sufficient to justify their use. The bark from next year's crop will be analyzed to determine, also, its production of salicine.

The experiments have yielded valuable information as to cultural methods, which will be published.

#### TREES OF THE PACIFIC STATES.

Progress was made in preparing for publication the first of the regional studies promised, the "Trees of the Pacific States." It will tell in untechnical language how to identify the species, where they are found, and what their silvical characteristics are. It is much needed by the local forest officers and the general public.

The revision of Bulletin 17, "Check List of Trees of the United States," has made progress.

The collection of wood specimens, preparatory to the work on the identification of woods of the United States, was begun. It will meet the actual needs of wood users, who are now sometimes imposed upon by material falsely named.

Great confusion now exists in distinguishing the various species and varieties of catalpa grown for timber, to the frequent injury of

the buyer of seed or stock. A circular is being prepared which will set forth the distinguishing marks and safeguard the planter.

#### CARE OF STREET AND PARK TREES.

Many demands for advice in caring for shade trees are made upon the Service. In the absence of any satisfactory treatise on the subject, material for an illustrated circular dealing with it is being collected. Examples of correct methods are now furnished by trees in Washington, D. C., which have been cared for under the advice of the Service.

An offer of assistance to cities in naming and labeling their trees brought a number of requests for this help. The city of Richmond asked and received an examination of its trees and recommendations for their care.

#### FOREST HERBARIUM.

This collection contains specimens of typical foliage, fruits, seeds, bark, and wood of approximately 400 of the 645 native species, and 150 foreign trees, or about 3,500 specimens altogether, besides a collection of 1,000 thin sections of foreign woods. Special effort is being put forth to make the collection of our native forest trees complete. The National Herbarium relies upon this office for tree identifications, and the Service herbarium is considered a part of the National Museum collection. It is widely and constantly used by members of the Service.

#### FOREST LIBRARY.

The forest library contains 9,291 books and pamphlets, of which 1,213 were added during the year. One hundred and seventeen volumes were bound. Plans for extending the use of the library to field officers are under way. The headquarters of 84 field officers will be supplied with bound copies of all Service publications likely to be of use, and of certain other standard forest books.

There was a notably increased use of the library by members of the Service this year. The library committee, in cooperation with the Librarian of the Department of Agriculture, completed a classified catalog of forest literature, including the literature of important auxiliary sciences accessible in the library of the Department. The whole presents a concise view of forest and related literature prepared for persons not trained in forestry. Constant requests received for lists of works on forestry suitable for general library and educational use show the need for such a publication.

#### FOREST PHOTOGRAPHIC COLLECTION.

The Service now has 24,462 mounted photographs, including 1,600 from foreign countries, of which 5,410 were catalogued and filed during the year, and 935 unmounted pictures. They are from 53 States and Territories and insular possessions, and 26 foreign countries. They are indexed by States, countries, and subjects, and are also platted by symbols on a map to show what regions they cover and to indicate where additions are most needed.

During the year 1,677 unmounted photographic prints were given away in response to requests from 28 different States, chiefly to 51 educational institutions and for illustrating 57 books and articles on forestry. Two hundred and ninety-seven prints were received by exchange.

One hundred and fourteen prints, 209 slides, 23 transparencies, and 8 bromide enlargements were sold.

The lantern-slide collection contains 3,581 slides, 700 of which were added during the year. One thousand slides and 31 transparencies were colored this year. The colored slides made by the Forest Service greatly surpass in truthfulness any others known to us.

Loans of 2,355 lantern slides were made for educational use to 56 applicants from 26 different States, as against 1,861 last year.

#### EXPOSITIONS.

The exhibit made by the Forest Service at the Lewis and Clark Exposition was closed October 15, 1905, and the material returned to Washington.

About 200 transparencies and bromide enlargements were sent to the New England Forest, Fish and Game Exhibit at Boston, Mass., beginning December 27, 1905.

#### WORK FOR THE ENSUING YEAR.

It is planned to continue for the regular period of three years during which a turpentine crop is worked, the study begun in 1905-6 of the effects of shallow and deep chipping and varying width of faces on the flow of resin and the life of the trees.

Much inquiry has been received from Western timberland owners as to the possibility of turpentering Western pitch pines. An investigation of this question will be undertaken. A study of the characteristics of turpentines will be continued. One result will be to show that untried pines may be profitably worked for commercial turpentine.

In connection with the experiments in basket willow growing already under way, an attempt will be made to ascertain whether, by the use of European stock, strains superior to any now grown here can be made available.

Special studies of various forest tree species and of forest types and their distribution will seek more accurate knowledge and data for mapping our forests and for regional manuals.

#### FOREST PRODUCTS.

The year has been marked by a higher standard of efficiency, combined with simpler and less laborious methods. The work is classified under the four sections of Wood Preservation, Dendro-Chemistry, Timber Tests, and Lumber Trade.

#### WOOD PRESERVATION.

The importance of preservative treatment of wood—railroad ties, mine timbers, telephone and telegraph poles, cross-arms, piles, fence posts, and even shingles and other forms exposed to rapid decay—



now receives marked and growing recognition. Treating plants are multiplying, and new methods and processes are being taken up. In this work the Forest Service has become a recognized source of aid and information.

The study of fence-post treatment with creosote in open tanks was carried further by experiments in southern California with eucalyptus, and in Iowa, in cooperation with the State college, with rapid-growth hardwood posts.

The seasoning of red fir, western hemlock, and western larch railroad ties in Washington and Idaho, in cooperation with the Northern Pacific Railway, is now finished, and the seasoned ties, part of which have been treated, are ready to be laid in the track for a durability test.

Seasoning and treating experiments with hemlock and tamarack ties in Michigan, in cooperation with the Chicago and Northwestern and Wisconsin Central railways, have shown that seasoning before treatment is highly advantageous. These experiments, which include tests of the effect of soaking before seasoning, will be continued for the coming year.

Arborvitæ and chestnut telephone poles, cut each month of the year, are now seasoning in Michigan and Maryland, respectively. In the latter State a soaking test is included. When seasoned, part of these poles will be treated and their comparative durability tested in service alongside of untreated and unseasoned poles. At Norfolk, Va., loblolly pine cross arms, cut each month, are undergoing experiment in soaking, seasoning, and grading preliminary to treatment. The importance of grading as the proportion of sapwood varies has been demonstrated. Both these classes of experiments are conducted in cooperation with the American Telephone and Telegraph and the Postal Telegraph-Cable companies.

A cooperative study of seasoning and treating poles and ties of California western yellow pine, western red cedar, and eucalyptus, and a similar study of loblolly pine mining timber used in Pennsylvania, were begun. The latter has already shown that timber should be peeled and seasoned for at least two months before shipment, and that open-tank treatment gives remarkably complete penetration of the preservative.

Addresses were given before the annual meetings of the Wood Preservers' Association, the American Railway Engineers and Maintenance of Way Association, and the North Carolina Pine Association.

The Forest Service does no work in wood preservation except in cooperation with those interested in the results. Every project has been subjected to careful and frequent inspection. The cost of the investigations are borne mainly, and in new work must be met almost entirely, by the cooperators, but the results are for the public use and are controlled by the Service, which seeks only the solution of problems of broad and general importance.

#### DENDRO-CHEMISTRY.

During the study of Michigan hemlock and tamarack ties, already mentioned, there were made chemical analyses resulting in over 580 zinc estimations, to discover the penetration of zinc chlorid, and microscopic examinations and measurements to learn the value of glue

tannin in treatment. A field test of the strength of zinc chlorid solution was devised, and preliminary work was done on the methods of analyzing and extracting creosote. This included the devising of a new method of estimating tar acids, comparative distillations, and tests to determine the best solvent for extracting creosote from treated timbers. A study of wood distillation, begun during the year, promises a new means of utilizing much of the present waste in lumbering.

A pulp-testing laboratory was installed at Boston, Mass., to investigate the paper-making possibilities of woods hitherto unused for pulp, especially of certain species abundantly supplied by the forest reserves. An anti-stain process of treating white pine sapwood in Michigan was investigated and found effective with proper piling.

#### TIMBER TESTS.

In all 12,033 mechanical tests were made, and as many moisture determinations, as against 8,210 last year. Each test involved an average of 35 measurements, a description and sketch of the stick before and again after the test, and the necessary computations and drawings. The tests were made at the various laboratories as follows: Yale, 1,856; Charleston, 190; Berkeley, 2,496; Purdue, 6,156; Portland, 259; Eugene, 872; Seattle, 204.

Tests were completed during the year upon loblolly pine to show the influence of sapwood and knots on the strength of structural timber; on red fir (in cooperation with the University of California); on Minnesota tamarack and Norway pine in large and small pieces; on the holding force of railroad spikes in treated and untreated loblolly pine and white and red oak; on the effect of preservative treatment on loblolly pine; on strength as affected by the speed at which a load is applied; and on the influence of defects upon loblolly pine harvester poles, which led to improved specifications.

There are still in progress tests of the strength of California eucalypts (in cooperation with the State of California) to learn whether the wood can be used in place of such structural timbers as hickory and oak; of the strength of red fir as modified by knots and other defects, rate of growth, and sapwood; of western hemlock from various localities of the Northwest, including Alaska, and of untried woods from the forest reserves; of the effect upon strength of various methods of seasoning; of the bending of beams under constant loads for long periods; of the behavior under a blow of buggy spokes, axles, and wagon tongues; of resistance of street-paving woods to abrasion, indentation, and water absorption (in cooperation with the Office of Public Roads); of the bearing value of different forms of washers on wood stringers, and of the relative strength of live oak and black locust insulator pins.

Reports submitted for publication and now in press were: "Instructions to engineers of timber tests," "Effect of moisture on the strength and stiffness of wood," and "Experiments on the strength of treated timber." Reports were also prepared on the strength of various woods in the form of boxes, the strength of Philippine woods, the strength of timber treated by a nonsteaming process, the strength of loblolly and pitch-pine mine props, the strength of common and hardy catalpa, and the strength of African yew and red cedar.

Addresses were given before the Western Society of Engineers, the Engineering Congress at the Lewis and Clark Exposition, American Railway Engineering and Maintenance of Way Association, American Society for Testing Materials, American Car Builders' Association, National Advisory Board on Tests of Field and Structural Materials, and before Purdue University and the University of Illinois.

The Advisory Board on Tests of Fuels and Structural Materials, appointed by the President during the year, considered and approved the general plan of the timber tests conducted by the Forest Service.

The year fully demonstrated the need of a wood-testing laboratory. Such a laboratory will benefit the wood users of almost every class. A strong tendency to reform the traditional methods of handling and judging wood as a material, and to put commercial standards upon the more accurate basis of actual test is widespread. Plans have been drawn for a laboratory providing for tests along the three lines of preservative treatment of timber, the strength of wood and wooden materials, and the chemical problem of wood utilization.

#### LUMBER TRADE.

The Section of Lumber Trade was organized during the year. Its work has been of peculiar value both in giving the Forest Service systematic touch with large classes of wood users whose problems have not in the past been considered by the Forester and in enabling foresters to gain a thoroughly practical idea of the problems confronting the makers and users of forest products. The manufacturers of lumber and other forest products have been brought to realize more fully than ever before the possibilities of direct practical usefulness to them of the Forest Service. At all meetings of associations of wood users attended by members of the Service committees on forestry were appointed to further the work of the Service. Real progress is being made in promoting the most economical utilization of the forest products of this country.

With the aid of the National Lumber Manufacturers' Association the hearty cooperation of the secretaries of the leading associations of lumber manufacturers was secured early in the year in an effort to collect statistics of the annual production of lumber and other forest products, beginning with 1905. These statistics cover lumber, lath, shingles, slack and tight cooperage stock, pulp wood, cross-ties, tan bark, veneer stock, mine timbers, wood distillates, and other products. The reports upon mining timbers were secured through cooperation with the Geological Survey. The statistical work has aroused great interest among the lumbermen, and is of distinct value to them, as to the Forest Service.

The principal grading rules of lumber manufacturers in the United States have been compiled. To bring them together in one publication will show their inconsistencies and promote the movement toward the unification of grades, so desirable to both the producer and the user of lumber.

Field studies of the manufacture of slack and tight cooperage stock were made in the Northern and Southern States, with particular reference to possible economies in manufacture, the substitution of less valuable species, and the utilization of waste. Tables showing



the relative value of staves and lumber from trees of various diameters were prepared. These tables are of direct value to the owners of timber, cooperage-stock manufacturers, and lumbermen. A special study was made of methods of kiln-drying red gum heading.

A study of the woods used (including amounts and prices) in box making in the New England States indicates that the future of the industry in this region depends upon the control and conservative operation of timberland by the manufacturer.

A study of the woods used in vehicle and implement manufacture, made in the Central States, led to the extensive tests upon spokes, tongues, and axles now in progress at the Purdue laboratory, to determine the proper basis for grading hickory spokes and the effect of defects and methods of manufacture upon the strength of the parts. Arrangements were also made for tests of the suitability of several western woods for wagon manufacture.

A study of methods of treating and laying woods used for street paving was made in all the principal eastern cities where any considerable quantity of such paving is in use. A cooperative experiment with the city of Minneapolis, two creosoting companies, and several lumber manufacturers is in progress, to determine the value for paving of various kinds of northern woods.

A study of the methods of kiln-drying hardwood lumber was carried on in the North Central States. The report upon this subject will furnish a valuable contribution to the theory and practice of kiln-drying. Practical knowledge likely to be of great use to the Service was obtained.

A brief study of the conditions under which tupelo is manufactured in Louisiana and Alabama resulted in a series of practical recommendations for air seasoning this wood. An experiment in kiln-drying tupelo lumber has made it certain that this problem also will be satisfactorily solved. The manner in which the market for tupelo has expanded since announcement of this study was made furnishes a striking illustration of the practical value of the work.

Current prices, by grades and species, of practically all the commercial kinds of lumber in the United States, have been compiled for office use, and the prices of the leading species for the past twenty years have been printed. Because of the rapid changes now going on in lumber prices this compilation is particularly useful.

Fieldwork for a study of the possible means of utilizing dead and mature timber on reserves began May 1, 1906. It is expected to furnish practical recommendations for the use of a large amount of reserve timber which has heretofore gone to waste and been only a menace to the welfare of the forest.

A study of utilization of sawmill waste began July 1, 1905, but was dropped before results were obtained, for want of men to carry it on. Some important phases of the subject have been touched upon in a concrete way in connection with the study of cooperage and vehicle woods.

Addresses were made at well-attended meetings of the Mississippi Valley Lumber Manufacturers' Association, the Pacific Coast Lumber Manufacturers' Association, the Yellow Pine Manufacturers' Association, the Southern Cypress Manufacturers' Association, the National Lumber Manufacturers' Association, the National Slack Cooperage

Manufacturers' Association, the International Slack Cooperage Manufacturers' Association, and the National Box Manufacturers' Association.

#### WORK FOR THE COMING YEAR.

With the beginning of the fiscal year 1906-7 the organization of the Office of Forest Products will be considerably changed. Dendrochemistry will be designated Wood Chemistry. Timber Tests and Lumber Trade will be combined into the Section of Wood Utilization, and sections of Forest Measurements and Reserve Engineering will be added.

The Section of Forest Measurements, during the coming year, will work up analysis of white pine in Massachusetts and graded mill tallies of softwoods and hardwoods in New Hampshire; compute periodic weights and measurements from pole, tie, and cross-arm experiments; work up data on western species likely to be valuable in the work on the reserves, and compile statistics of forest products. Efforts will be made to gather new and supplemental figures on important trees. Rearrangement of data files on the basis of species and localities, already begun, will continue.

The principal work in map making will concern new forest reserves, timber sales, and working and planting plans.

Since the Office of Forest Products is in large touch with engineers and engineering work, it will be made responsible in the future for the more technical engineering work on the forest reserves. The work immediately ahead is that of telephone construction. The reserves are greatly in need of telephone service. Wherever possible the commercial telephone companies will be given permits to construct lines on the reserves on condition of reduced rates for official business, exclusive lines to reserve headquarters, and the privilege of tapping commercial lines with reserve branch lines. The use of water powers and the construction of roads may also demand technical attention during the year.

The Section of Wood Preservation will consider: Wood above ground, such as railroad ties, paving blocks, cross arms, etc.; wood in water, such as piles attacked by the teredo; and wood underground, such as mine props, and the butts of fence posts and telegraph and telephone poles.

In the Section of Wood Chemistry the Boston pulp laboratory, now ready for operation, will test the quantity and quality of pulp obtainable from many different American woods, particularly those from the forest reserves. A study of the distillation of wood will be resumed. A careful study of creosote as a preservative will include methods for quantitative estimations of creosote in timbers, for detecting adulterations of coal-tar creosote, and for analyzing creosote by fractional distillation. The leaching properties of timber will be studied, including tests to determine the constituents of woods at different seasons, the nature and quantity of materials removed by soaking, changes of insoluble wood constituents during soaking, and the effects of leaching on the subsequent growth of attacking fungi and on seasoning. There is an increasing tendency among commercial companies to seek the help of the section in solving chemical problems concerning the use of wood. Problems of this kind, the so-

lution of which will be generally useful, will be undertaken when the cooperator will bear the expense.

The various timber-test laboratories will continue work already begun. The studies of cooperage woods, box-board woods, and vehicle woods, and of lumber movements, specifications, and prices will also be continued. Annual statistics of forest products will be collected in cooperation with the Bureau of the Census and the lumber associations interested. The use of dead timber on the forest reserves will be given much attention. This timber, of which there are vast amounts, has been considered commercially useless. It increases the danger to the reserves from fire. Much of it is still sound, and every effort will be made to use it.

#### RECORD.

#### ACCOUNTS.

Accounts include the three subsections of receipt, disbursement, and bookkeeping. All funds derived from the sale of products of the forest reserves, from the use of the reserves, or from cooperation are received in the first; all disbursements for the Forest Service are made in the second; while all administrative bookkeeping, liability and cost keeping, and property accounting is done in the third.

Up to November 25, 1905, all moneys received from the forest reserves were deposited and held in the Central National Bank, Washington, D. C., a United States depository, until transferred, by order of the Forester, to the Treasurer of the United States, to be credited as unofficial moneys to the appropriation "Administration, etc., Forest Service." All moneys received since that date were deposited directly with the Treasurer of the United States, to the credit of this appropriation. This method materially reduced the labor, cost, and chance of loss involved in handling the receipts, and promoted effective inspection.

#### SUPPLIES.

The work formerly done by the property clerk was divided, and those duties which relate to accountability for property were assigned to a property auditor. The property clerk retained the custody of supplies in stock, and issues them on requisition. Improved methods of packing and shipping were introduced to keep pace with the increasing needs of the Service.

#### PHOTOGRAPHIC LABORATORY.

A new system of informing field members of the Service of the results of their photographic exposures led to a marked improvement in the views. A table which will enable field members to time their exposures correctly was compiled, and specific instructions for taking forest photographs were prepared. The increased photographic needs of the Service during the year were fully met without increase in the number of persons employed in the laboratory.



## QUARTERS.

Twenty-two additional rooms were rented during the year. Eleven of these were for office use, 7 for the storage of instruments, machinery, field equipment, and office supplies, and 4 for the accommodation of a newly installed lithographic printing press and for map mounting. The increased office work connected with forest reserve administration will make necessary a further extension of quarters during the coming year.

## CORRESPONDENCE.

During the year 145,468 official communications were received in the Forest Service, and 252,092 were sent out.

## STENOGRAPHY AND TYPEWRITING.

The value of the concentration of stenographic work was shown in the readiness with which the needs of the Service were met. The proportion of the cost of stenography and typewriting to the entire expenditure of the Service was reduced from 4 to approximately 3 per cent. During the year 2,142 items of work were performed, comprising 31,936 typewritten pages (including 5,018 pages tabulated), 644,425 mailing-list cards, 141,220 mimeographed sheets, and a largely increased amount of miscellaneous work. In addition, 571 temporary details of stenographers were made to offices for a total of 5,266 days. The average number of stenographers and copyists assigned to this section was 34.

The concentration of clerical work was extended during the year by including in this section a number of clerks for routine work and for detail to offices in emergencies. The result was a high degree of efficiency in the clerical force without a proportionate increase of expense. During the year ninety-five details of clerks were made, for a total of 1,207 days. The average number of clerks assigned to this work was 9.

## MAILING LISTS.

The mailing lists of the Service comprise: (1) A special list of libraries; (2) a list of representative newspapers; (3) a small foreign list of scientific and governmental institutions; (4) a special list of persons engaged in forest work in the United States; (5) a general list of persons interested in forestry; (6) a large extra list of lumbermen, timber-land owners, farmers, and members of various professions.

To the names of the first four lists, numbering in all 4,870, all publications issued were sent. Those on the general list received notice of the appearance of bulletins, with brief descriptions of their contents, and also circulars of information and certain other publications of general interest. The addresses on the general list now number 20,100.

The extra list is classified, and is representative of all sections of the United States. Effective use was made of it during the year in bringing the work of the Service to the attention of those most interested in the results.



## REPORT OF THE CHEMIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY,  
*Washington, D. C., September 1, 1906.*

SIR: I have the honor to transmit herewith the annual report of the work done in the Bureau of Chemistry during the fiscal year ended June 30, 1906, accompanied by a statement of the work proposed for the current fiscal year.

Respectfully,

H. W. WILEY, *Chief.*

HON. JAMES WILSON, *Secretary.*

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### BRIEF REVIEW OF THE YEAR'S WORK.

The activities of the Bureau during the fiscal year ended June 30, 1906, extended over a great variety of investigations connected with the progress of agriculture and the utilization of its products for food and other purposes.

In the dairy industry, the work authorized by law in connection with the Bureau of Animal Industry for the enforcement of the act relating to renovated butter was continued in the investigation of over 800 samples for the purpose of seeing if they complied with the requirements of the law. Many other investigations looking to the improvement of dairy products were also inaugurated. Chief among these has been the study of the effects of cold storage upon the chemical composition of milk and cream. The object of these investigations was to determine the length of time during which such products could be safely kept in cold storage.

Studies looking to the determination of the effect of environment upon the content of sugar in Indian sweet corn were made in the Sugar Laboratory under the supervision of the Chief of Bureau. The almost universal use of this product for food purposes throughout the whole country renders such an investigation of peculiar interest to the consumers as well as to the producers of sweet Indian corn. A single variety of seed was planted over a wide extent of territory from South Carolina to Maine, and the content of sugar in the product carefully determined. At the same time, meteorological data were secured, which are utilized in determining the effect of environment in all of its factors upon the composition of the product. These studies are a continuation of those concluded last year upon the effect of environment on the chemical composition of the sugar beet.

One of the most important results of this investigation has been the determination of the rapidity with which the sugar disappears from the grains of the corn after the ear is separated from the stalk.



Within twenty-four hours after harvest, if exposed to ordinary temperatures, a very considerable percentage of the sugar has disappeared. This has led to the observation that it is necessary to market the product as soon as possible after harvest, and meanwhile to keep it at as low a temperature as can be secured.

Further studies of the same character were undertaken in collaboration with the Bureau of Plant Industry, looking to the improvement of the different varieties of Indian corn by selection, based upon analytical data. In all, over 3,000 analyses were made of cereals in the prosecution of the above investigations. These investigations also include the effect of environment upon the chemical composition of barley as related to the brewing industries and co-operative work on wheats, etc., described in detail under the Cereal Section. While these investigations are not completed, they have gone far enough to show the great value of such studies in relation to practical agriculture.

An important investigation was also begun upon the economic production of alcohol from various raw materials in relation to the production of denatured alcohol for industrial purposes. The object of this investigation was to discover the value of various waste materials of factories—the use of wood, molasses, sweet potatoes, corn stalks, etc., for the purpose mentioned. This work is certain to prove of immense value to our farmers in developing new sources of income from the increased utilization of such products and by-products. One of the most promising sources of alcohol among these appears to be the waste from corn and other canning factories. At the request of packers in Hoopeston, Ill., an agent was sent from the Bureau to cooperate with them in experimental work to determine the value of these wastes. It was found that, roughly speaking, the wastes amounted to 40 per cent of the total weight of corn brought to the factory, not counting the husks as available, though they amount to about one-third of the total weight of the corn. As the result of a long series of tests on the various waste products, it was found that it was possible to produce from them from 6 to 10 per cent of alcohol, with a safe average of 8 per cent, or a yield of 3.2 per cent of alcohol calculated on the total weight of corn hauled to the factory. On account of the expensive machinery and other apparatus required in the manufacture, it is hardly possible that a small factory could engage in the alcohol business, but a large factory could do so with apparent profit, or, where several factories were located within a short radius, by shipping their wastes to a central plant they might be utilized to advantage.

Investigations are also in progress, by a special agent, to determine the causes of spoilage in canned goods, especially corn, tomatoes, and peas, in relation to the chemical changes which occur therein. In this connection the sugar content of the corn is considered, that the question of adding sugar to the canned product may be answered.

The general work of the Sugar Laboratory included the analysis of 585 samples, consisting chiefly of sugar beets, sugar-cane juices and sirups, maple products, and a variety of cereals, malts, and other materials from the various laboratories of the Bureau. The four-year experiment in the fertilization of sugar cane and the experimental work in the production of table sirup therefrom has been completed, and the final report has been issued as Bulletin 103 of

this Bureau. The work of the Sugar Laboratory, which has for several years been conducted under the direct supervision of the Chief of Bureau, will in the future be in charge of a chief of laboratory.

The work in chemical enology on the cultures of yeast for the production of superior ciders was compiled for publication, and during the current year it is expected to extend the scope of the work, the botanical phases of the same to be conducted in connection with the Bureau of Plant Industry, and to organize a laboratory for these special studies.

An important investigation has also been made in collaboration with the Bureau of Plant Industry for the determination of the quantity of hydrocyanic acid (prussic acid) and of starch in cassava. Cassava is one of the most important plants of tropical or subtropical production. The presence of this violent poison, however, in cassava unfits it, as a rule, for human food and also for stock feeding. The object of the investigation was to determine what varieties produce the smallest amounts of hydrocyanic acid and what would be the effect of selection upon their production, the purpose being to procure varieties as free as possible from this injurious substance in order that they might be utilized as food and in the production of starch and products made therefrom. A report on these points has been prepared.

A very important part of the work of the Bureau is that undertaken in the Contracts Laboratory, the object of which is the examination of materials furnished to different Departments of the Government under contract. These examinations, enumerated in detail under the report of the laboratory, were of the most rigid character, and the result of the work has been to secure a much higher quality of material than was formerly supplied under the contract system.

The work in the examination of drugs has been particularly fruitful during the year. A large part of the work has been in connection with the Post-Office Department for the purpose of suppressing traffic in fraudulent preparations transmitted through the mails. As the result of our investigations, a large number of fraud orders has been issued forbidding the use of the mails for the purposes above mentioned. Many other important investigations were also undertaken in the testing of chemical reagents, of oils and essences, and of plant drugs in connection with the Bureau of Plant Industry.

The work in the examination of waters used as beverages has been continued and also the analyses of waters used for irrigation purposes. A bulletin on the "Mineral Waters of the United States" was published during the fiscal year. Studies were made also of the lime-sulphur-salt wash and allied mixtures used as insecticides.

One hundred and fifty-four samples of cattle food were analyzed to determine the quality of the cattle foods sold upon the markets. Important studies were also made of the injurious effects of fumes from smelters upon vegetation, and testimony was given in the courts relating thereto. It is evident that the sulphurous-acid fumes produced in most smelters are of a character to injure vegetation and also animal health in a region very widely extended about the factory. It appears probable that in the near future smelters will be required to convert the sulphurous acid into sulphuric acid or some other substance which will prevent the injuries above mentioned.

Important progress has been made also in the study of tanning materials, especially of the Sicilian sumacs. Studies were made respecting the effect of different tanning materials upon the character, quality, and durability of leather. Investigations of great importance, not only to the various Departments of the Government, but to the public in general, are those relating to the character of paper which is used for preserving public records. Investigations respecting the composition of turpentine distilled from wood and its relation to the ordinary turpentine have been continued.

#### FOOD-INSPECTION WORK.

The extension of the food-inspection work at the ports of entry has been extremely beneficial. The work at all the ports has been increased, especially at New York, Boston, and Philadelphia. The San Francisco earthquake in April destroyed our laboratory at that point, rendering it necessary to temporarily suspend the inspection at that port. The work, however, is soon to be resumed at Berkeley, Cal.

The effect of the food inspection on foreign commerce has been most salutary. In many cases food products which were formerly very generally misbranded are now found to be properly labeled, and there has been a very decided improvement in the quality of imported food products due to inspection. The Division of Foods has also, in addition to the work already mentioned, conducted special investigations into the extent of domestic adulteration of food products and an investigation, in connection with the Division of Pomology of the Bureau of Plant Industry, of tropical and subtropical fruits, as well as of fruits of domestic production.

A very extensive investigation was made to determine the character of distilled liquors, both those imported into the United States and those of domestic manufacture. These investigations have been practically completed, but the results have not yet been published.

The study of the effects of colors, preservatives, and other substances added to foods has been continued during the year, and most valuable data relating thereto have been secured, which are now preparing for publication. The value of this investigation is particularly great because of the fact that the experiments are made upon human beings. The establishment of a Physiological Laboratory for the segregation of all experimental work of this nature will probably be effected during the current year.

The micro-chemical investigations during the year have been extremely fruitful. The microscope has become one of the most valuable adjuncts in the examination of food products and materials used for technical purposes. To this end micro-chemical investigations, including bacteriological examinations, have been made in connection with the other work of the Bureau of Chemistry and extended not only to foods, but also to leathers, papers, and tanning materials. The bacteriological-chemical work has been of extreme importance. This is especially true in connection with the work authorized by Congress for studying the effects of cold storage upon the wholesomeness of food products. Particularly in studying the question of the relative merits of drawn and undrawn fowls when placed in cold storage the bacteriological-chemical examination is



one of vital importance. To this end studies are making to determine whether the bacteria of the intestinal tract migrate to the flesh of the fowl during the period of cold storage; and if so, what chemical changes are produced thereby.

The bacteriological-chemical investigations have extended to a large number of subjects, but have been particularly directed to the chemical changes which take place in milk, cream, and evaporated and condensed milks, and to the general changes of a bacteriological character which foods undergo in storage.

## WORK OF DIVISIONS AND LABORATORIES.

### DIVISION OF FOODS.

The study of the influence of preservatives on nutrition was continued. The plan followed was somewhat different from that previously employed, since the work during the past year was for the purpose of extending the studies in some directions that had not been undertaken in the earlier experiments. Especial attention was given to the study of the nitrogenous bodies in the urine and the influence of the principal food preservatives upon the relative amount of these bodies; also to the various compounds of sulphur in the urine and the relation between them and the nitrogenous bodies.

The study of the composition of fruit with special reference to the changes which take place during the ripening and to the influence of different methods of storing on the composition of the fruit has been continued in collaboration with the Division of Pomology of the Bureau of Plant Industry. In the study of the ripening of fruit particular attention was given to the orange, persimmon (both Japanese and native varieties), strawberry, raspberry, and avocado.

The samples of oranges were obtained in the Department green-houses. This fruit is peculiar in the fact that at all stages of its growth the total sugars are divided about equally between reducing sugar and sucrose. The marc of the orange is formed very early in its history and remains constant in weight during the growth and development of the fruit. The acids are also formed at an early stage, and apparently increase gradually and slowly in actual weight. The storage of the fruit at all stages of its growth results in slight loss of total sugar, a marked increase of reducing sugar, and a corresponding loss of sucrose. The loss of sugar noted above is to be explained, as in the case of apples, by the consumption of reducing sugar as a result of the respiration of the fruit. The weight of marc remains practically constant, and the weight of acid appears to decrease slowly on storage during the various stages of the development of the orange.

The persimmon was selected largely because of its relatively large content of tannin. In this fruit the sugar was found to consist almost entirely of invert sugar. It was found that the disappearance of astringency coincident with the ripening of persimmons is due not to the disappearance of tannin, but to the fact that the tannin is converted into an insoluble form within certain specialized cells.

The study of the chemical changes occurring in the manufacture of cider vinegar on a commercial scale and the composition of cider and wine vinegar of known methods of manufacture has been continued.

The division has also continued the study of the occurrence in nature of the chemical substances ordinarily used as food preservatives. A number of determinations have been made of the amount of such substances in various fruits. Search was made in the following fruits and vegetables for benzoic acid, with negative results: Malaga grapes, grape fruit, oranges, pineapples (two varieties), carrots, parsnips, cauliflower, rhubarb, and green peppers. Eighty samples of salt from different localities in the United States were examined for boric acid, which was found to be present in all cases in amounts varying from less than 1 part per million to 1 part per 3,500.

The work begun during the preceding year on distilled liquors was continued during the last fiscal year. In all 1,088 samples of whisky, brandy, and rum were examined. The purpose of this work was to secure data for the establishment of standards of composition. The samples examined were mainly of known origin. A large number of samples of whisky and brandy were obtained through the Bureau of Internal Revenue, which supplied full information regarding their manufacture. Samples of French brandy were also secured, with authoritative information regarding their manufacture. Additional samples were purchased in the open market and taken at the port of entry, in order to determine the character of liquors commonly sold and imported for sale.

Methods for the examination of flavoring extracts have been extensively studied, and a series of extracts have been prepared for the purpose of testing the methods and for use as standards. A systematic examination of the flavoring extracts sold in the retail trade is in progress.

Complaint has repeatedly been made that a considerable portion of the rice consumed in the country is so modified by manufacture as to decrease its nutritive value, and that certain substances, such as talc and similar products for coating and paraffin and oils for glazing, are commonly employed. A series of samples of unhulled rice has been obtained and prepared for examination in the laboratory. Samples of known origin from various mills have also been secured, and an extensive series of samples has been purchased in the open market and taken from shipments of imported rice. The examination of these samples is now in progress.

The Department has taken the attitude that edible oils imported from districts famous for the production of olive oil will be understood to be represented as olive oil unless otherwise designated. Certain importers have questioned the propriety of this decision, on the ground that olive oil is not the leading edible oil of the countries mentioned. In order to determine this matter, 450 samples of edible oils were secured from the retail trade by the American consular officers in the olive-oil producing countries of Europe. These samples are now under examination.

Attention has also been given to the study of methods for the examination of foods. Although much progress has been made in the last ten years in the methods employed for studying the nutritive value and the purity of foods, much yet remains to be done. Manufacturers do not fail to take advantage of their knowledge of methods employed by official chemists in judging of their products and very often only attempt to place on the market articles that will withstand examination by those methods. An important part of the

work of the food-inspection chemist, therefore, is to keep abreast of methods that have been suggested and to elaborate new methods or to modify old ones so as to make them applicable under the new conditions that constantly arise. The work in this line has been undertaken largely by the requirements of the regular work of the Division.

A study of methods for identifying and determining the relative amount of nitrogenous compounds in meat extracts and in other foods was continued and the results reported to the Association of Official Agricultural Chemists. In this field material progress was made in the method employed for the separation of peptones from the so-called meat bases. It is believed that in the data given in earlier reports the percentage of meat bases was relatively too high and the percentage of peptones correspondingly low.

A study of the methods for the detection and quantitative determination of preservatives in foods was continued. The quantitative determination of these preservatives is a subject to which careful attention has only been given very recently, but its necessity is becoming more obvious as our information in regard to the occurrence of these substances in nature, as noted above, is extended. During the last year special attention has been given to the determination of salicylic acid and fluorids, and progress has been made in both.

The greater part of the energy of the Division of Foods has been devoted during the past year to the enforcement of the imported-food law. Port laboratories have been established in Chicago, Boston, Philadelphia, and New Orleans. Much time has been occupied in equipping these laboratories, and their organization has resulted in a largely increased efficiency in the enforcement of the law. The following is a tabular statement of the shipments examined in the enforcement of the law:

*Number of imported food samples received by the Bureau of Chemistry during the year ended June 30, 1906, with results of inspection.*

Result of inspection.	Wine.	Meat.	Olive oil.	Vegetables.	Fruit products.	Beverages.	Spices and condiments.	Fish in oil.	Vinegar.	Egg products.	Miscellaneous.	Total.
Found contrary to law:												
Released without prejudice to future decisions in similar cases.....	31	6	3	124	59	87	62	18	16	11	114	581
Admitted after the labels were changed to harmonize with the law.....	1	2	1	81	85	86	48	40	42	....	191	577
Required to be reshipped beyond the jurisdiction of the United States or destroyed.....	6	8	....	11	23	17	15	21	13	8	16	138
Total contrary to law.....	38	16	4	216	167	190	125	79	71	19	321	1,246
Found to comply with the law.....	395	85	313	457	744	470	332	743	112	162	690	4,503
Total number of samples examined from invoices detained.....	433	101	317	673	911	660	457	822	183	181	1,011	5,749
Samples taken from invoices not detained.....	....	....	....	....	....	3	3	32	2	4	5	49
Samples inspected on the floor of the examiner's room in appraiser's stores and invoices not detained.....	....	....	....	....	....	....	....	....	....	....	....	as, 735
Shipments gone into consumption before receipt of our notice to relabel.....	....	....	....	....	....	....	....	....	....	....	....	10

a Beginning October 1, 1905.



It is only when it is remembered that each of the inspections made is of a shipment of goods usually of considerable magnitude that the full meaning of the work can be understood. A simple inspection of the label is often sufficient to indicate whether or not the goods are in compliance with the law. For instance, canned peas have been found to be free from extraneous matter except copper, which is added for coloring. If the presence of copper be declared on the label, it is evident that a chemical examination of the sample is not necessary. Shipments, therefore, which are inspected merely with reference to the label and from which samples are not taken to the laboratory are entered separately in the tabular statement just given. Attention should be called to the fact, however, that at the beginning of the year a record was not made of the shipments which were merely inspected for label, and that the record given in the table begins with October 1, 1905.

A beginning has been made on the study of the effect of cold storage upon the healthfulness of foods. Fresh eggs, chickens, and quails prepared according to ordinary market conditions have been placed in cold storage, and samples are examined at suitable intervals.

During the last fiscal year, in addition to the investigation of methods and other comparative studies for which materials in the laboratory were used and special samples were not required, the Division of Foods examined 5,798 samples of imported foods, 222 samples relating to the hygienic table, and 2,529 miscellaneous samples, making a total of 8,549 samples.

#### DAIRY LABORATORY.

During the year 818 samples were examined in this laboratory. The greater part of this number represent work done either for the Dairy Division, Bureau of Animal Industry, in the enforcement of the renovated-butter law or in cooperation with that division in an extended study of American cheese.

The total number of samples of butter, milk, and cream examined for the Dairy Division was 569, of which over 500 were samples of butter examined with reference to possible violation of the butter laws. The facts thus obtained have been used by the Bureau of Animal Industry in enforcing the law and in educating the butter renovators and creamery-butter makers to the necessity of a more strict control, especially of the water content of their product.

In the cheese investigation carried out cooperatively with the Dairy Division 146 samples, representing different ways of making, different ages, and different temperatures of ripening, were not only analyzed, but also studied in regard to their comparative digestibility by the method of artificial digestion in solutions of pepsin and pancreatin. The results of this investigation are now preparing for publication.

The remaining 103 miscellaneous samples of dairy products and dairy materials were received from various sources, and include samples of condensed milk, dried milk or milk powder, human milk, butter colors, and ice cream, in addition to 28 samples of cheese, used in studying methods for determining the comparative digestibility of different cheeses by artificial means.

Within the past year the chief of this laboratory has made his second report as referee on dairy products to the Association of Official Agricultural Chemists, a report which deals with a large amount of research work and is published in the Proceedings of that association for 1905.

#### MISCELLANEOUS LABORATORY.

During the last year the Miscellaneous Laboratory has examined 695 samples. Some of these analyses were made as part of the work in special investigations of the laboratory which will be published later, and part were performed for other Bureaus and Divisions of this Department and other Departments of the National Government.

The work of the Miscellaneous Laboratory naturally divides itself into five different sections, which will receive separate treatment. These sections are as follows: First, waters; second, insecticides and fungicides; third, miscellaneous; fourth, cattle foods; fifth, the study of the effects of trade wastes on agriculture.

#### WATERS.

The water section has during the last year examined 31 samples of irrigation waters for the office of Irrigation and Drainage Investigations, and has made various chemical studies of special subjects that were of particular interest to that office. Forty-one complete mineral-water analyses were also made. The majority of these analyses were for the purpose of continuing a study of American mineral waters from source, which has occupied the attention of this section during the last year or two. Of sanitary examinations 44 have been made, the majority of which will be published.

#### INSECTICIDES AND FUNGICIDES.

The insecticide and fungicide section has examined 39 samples of insecticides. Twenty-seven of these were made at the request of the Bureau of Entomology or the Bureau of Plant Industry. Twelve samples were examined for special investigations and the results will be published later. This section has completed, during the past year, two very important insecticide investigations which are now ready for publication, viz, chemical studies of the lime-sulphur-salt wash and closely allied mixtures, and methods of analysis of lead arsenate. A paper on the Hydrogen-Peroxid Method of Determining Formaldehyde, and the Report of the Referee on Insecticides and Fungicides for the Association of Official Agricultural Chemists, were also submitted by this section.

#### MISCELLANEOUS.

The miscellaneous section has charge of the work of a miscellaneous character that comes into the Bureau of Chemistry, and has during the last year examined 200 samples. These samples are received from nearly all the Departments of the National Government, and many of the Bureaus and Divisions of the U. S. Department of Agriculture.

## CATTLE FOODS.

The cattle-food section has examined 154 samples. Forty of these examinations were made in the interest of a study now making by this laboratory in collaboration with the Office of Farm Management, Bureau of Plant Industry, on forage crops of the arid and semiarid West; 20 were of a miscellaneous character, and 94 were more or less complete analyses of malts and barleys, the results of which will be published.

A considerable portion of the time of one member of the cattle-food section, who was appointed by the Association of Official Agricultural Chemists as referee on cattle foods, has been given up to investigations of methods of analysis of this group of substances. This section has almost completed the analytical work of a study that has been in progress for the last two or three years on the composition of cattle foods sold on the American market, and will shortly present the results of the investigation for publication.

## TRADE WASTES.

The section for the study of the effects of trade wastes on agriculture has made two very important investigations during the last year. One of these required the examination of 186 samples and was made at the request of the Bureau of Forestry. The results of the work will be published by that Bureau under the title of "Injury to Vegetation by Smelter Fumes Near Ducktown, Tenn." The results of the other investigation have been published in the Journal of the American Chemical Society under the title of "Copper Salts in Irrigating Waters."

## DRUG LABORATORY.

During the past fiscal year 553 samples of material were examined in this laboratory. Of this number 293 were chemical reagents, 121 proprietary medicinal remedies, 50 samples of whisky oils and essences, 37 samples of hops, 27 plant products for the Bureau of Plant Industry, 9 articles for the Bureau of Entomology, and 16 samples of a miscellaneous character.

## CHEMICAL REAGENTS.

The chemicals examined were those regularly employed in chemical analyses in the Bureau of Chemistry, delivered on contract and special purchases. The objects of the examinations during the past year were the same as recorded in last year's report—i. e., to insure the receipt of reliable chemicals for analytical work, to secure data upon which standards may be based, and to place competitors on a uniform basis. The kinds of chemicals used and purchased were the best of their respective types. It is necessary again to state that a goodly proportion of the chemicals delivered were of inferior quality, but it is also true that the proportion of rejections during the past year was smaller than in the previous years. Dealers are beginning to understand that it is necessary to label their goods in conformity with the contents of the packages, but this is not as yet generally recognized. Many chemicals are still labeled to indicate a



high grade of goods when, as a matter of fact, the chemicals are of inferior quality. The designation "Chemically pure" is markedly misleading at present, but the tendency is to deliver goods which conform more nearly to what this term should represent.

The committee on the testing of chemical reagents of the Association of Official Agricultural Chemists, of which the chief of the Drug Laboratory is the chairman, in its second report again set forth the necessity of carefully testing chemical reagents before they are employed for any accurate analytical operations. The committee is continuing its work, and the Drug Laboratory now has in its possession the analytical data for approximately 1,000 chemicals. These results and the standards required for the various chemicals will be published.

#### PROPRIETARY MEDICINAL REMEDIES.

Of the 121 proprietary medicinal remedies analyzed, 49 were examined for the purpose of gaining information of a general character, 22 were examined at the request of Members of Congress for information in connection with the food and drugs act, and 29 were examined in cooperation with the American Medical Association. The Post-Office Department also asked during the course of the year that investigations be made of 21 remedies of a questionable nature, which, through their advertising literature, were heralded as being capable of curing all forms of disease. The composition of these various remedies and the means employed for the purpose of effecting their distribution were unique in a great many cases. Some of them contained strychnine as one of the active ingredients. The virtue of one of the "consumption cures" was claimed to reside in cannabis indica, but an examination showed that the most active part of the medicine was morphine. Another "consumption cure" consisted of an ordinary tincture of ferric sulphate, with a very small amount of manganese sulphate. It was claimed to be a "positive and recognized cure" for this disease. Some of the results obtained at the instance of the American Medical Association have been published in the official organ of the association.

#### WHISKY OILS AND ESSENCES.

Fifty samples were analyzed for the purpose of determining approximately the composition and nature of the agents employed in preparing artificial liquors of various ages from raw spirits. The work presented many difficulties, and some of the problems are yet unsolved.

#### HOPS.

Thirty-seven samples of hops for export trade were examined for the presence of arsenic in order to ascertain whether the amount of arsenic was sufficiently low to permit entry of same into England under the rules and regulations of that country. Twelve samples were virtually free from this impurity, 9 contained an excessive amount—that is, more than 0.01 of a grain of arsenic to a pound of hops—while the remaining samples contained from a trace to less than the limit specified by the English regulation.

## PLANT DRUGS.

The plant drugs examined during the past year consisted almost entirely of those submitted by the Bureau of Plant Industry. These samples were examined as to the amount of active constituent present. The second report of the chief of the Drug Laboratory, as the referee on medicinal plants and drugs of the Association of Official Agricultural Chemists, was presented at the twenty-second annual convention. The report clearly indicated the necessity of more careful cooperative work along this line before it can be definitely stated that we are in possession of a method that will be satisfactory in the hands of the average analyst for the determination of morphine in opium. The work at present consists in the testing of the various analytical methods of recognized merit for estimating the various active constituents of opium, cinchona bark, ipecac, and nux vomica.

## APIARY PRODUCTS.

The Bureau of Entomology requested an examination to be made of several samples of honey—first, for the purpose of ascertaining whether the honeys contained any poisonous agents which could have been derived from the sources from which the honey was collected, and, second, an examination of samples of honey for the purpose of ascertaining whether any poisonous or deleterious substance has been mingled with the bee food. It was also considered advisable to examine the bees to ascertain whether or not the poisonous agent might possibly be disseminated in the tissue of the bees themselves. It was found that the honey was contaminated with an alkaloidal substance, but no trace of the poison could be found in the bees. An analysis of the plant from which it was supposed the bees collected the honey was also made, and it was found that the suspected plant contained a considerable quantity of a poisonous body similar to the one found in the honey. One sample of honey which was supposed to have been produced as the result of an unwholesome food was found to be filled with yeast plants. Another sample was found to be pure as far as could be ascertained by the ordinary chemical methods.

## MISCELLANEOUS.

The alcohol content was determined in two samples of medicinal remedies for the Treasury Department. A sample of candy was analyzed for the Department of Commerce and Labor. Two samples of sulphur were tested for the presence of arsenic for the Bureau of Plant Industry, the object being the location of the source of the arsenic found in the hops referred to above. Sulphur is used for the purpose of bleaching hops, and it is supposed that by this means the arsenic contained in the hops would contaminate this commodity. The remaining miscellaneous samples consisted of headache powders, opium, beeswax, etc.

## COD-LIVER OIL.

The investigation begun two years ago on cod-liver oils was continued during the past year. Authentic samples of cod-liver oil had been collected from various fishing ports throughout the world. The

prime object of the investigation is a comparative study of the American and Norwegian oils, both chemically, medicinally, and commercially, with a view to ascertaining whether or not any good reasons exist for the present discrimination against American oils by the medical profession, and, if so, what they are and how they can be removed. The work is done in cooperation with the Division of Foods of the Bureau of Chemistry and the United States Bureau of Fisheries. Most of the chemical work bearing on the composition of the oils has been completed. The experiments relative to the keeping qualities of the oils are in progress. Analyses to ascertain whether or not the ordinary cod-liver oil on the market contains any medicinal agents which could exert a beneficial influence in disease, excepting that of the nutritive value of the oil itself, are now in progress. It has been found that the ordinary chemical methods generally employed for the purpose of differentiating cod-liver oils from other liver oils derived from marine sources are virtually worthless. Almost all the oils possess similar reactions; in fact they approximate one another so closely that it is impossible for even an expert to differentiate between them.

#### DRUG LEGISLATION.

This subject was referred to in last year's report, and the reasons for collecting the laws into bulletin form were given. The bulletin contains all Federal and State laws (including the National food and drugs act) bearing on drug adulteration and the proper labeling of the same.

#### CONTRACTS LABORATORY.

During the past year there were examined in this laboratory 470 samples, in addition to the testing of about 500 samples of whisky for coloring matter. A very large part of the work of the laboratory has been done for other Departments, as the following summary will show:

	Number of samples.
War Department.....	69
Navy Department.....	19
Interior Department.....	65
Treasury Department.....	36
Post-Office Department.....	73
Department of Commerce and Labor.....	1
Department of Agriculture, Board of Awards.....	59
Government Printing Office.....	73

The character of samples analyzed was also quite varied, comprising lubricating oils, pigments, glues, glycerin, inking pads, inks, soap, face powders, coal, glassware, disinfectants, coffee, and numerous other miscellaneous substances. The routine work, as shown by these samples, is so varied and extensive as to consume the greater part of the time.

Several investigations of methods have been conducted and results published in scientific papers and bulletins, including work on writing inks, typewriter ribbons, reducing sugars, and artificial colors in whiskies.



## PLANT ANALYSIS LABORATORY.

The cassava investigations in collaboration with the Bureau of Plant Industry have been continued. Work was conducted at Biloxi, Miss., in which a series of about 100 plants was studied with reference to the relation of seedlings to the parent plant in the development of seedling varieties. After this the work at Miami, Fla., was continued, in which variety studies were made, about 250 plants being examined.

Experiments were conducted with reference to putting the crop in a marketable condition before leaving the farm, in order that the producer may not be dependent upon the starch mill as the only market. To this end some practical experiments were made in drying the product, which demonstrated the feasibility and economy of the process.

Upon the dried product considerable time has been spent in a study of its feeding value and the possibility of making a second grade starch by dry milling, with particular reference to its use as a material for the sizing of cotton goods and yarns. Also, experiments on cassava are conducting with reference to the manufacture of alcohol as a product to be denatured and used in the arts.

During the year complete analyses were made of 36 tobacco samples, and a series of experiments on the burning qualities of tobacco was conducted. These tests were on the raw product, in which the mechanical conditions were reduced to uniformity. For this purpose the samples were reduced to a powder and raised to a constant moisture content, then made into briquettes by means of an hydraulic press, after which they were burned under uniform conditions.

Fifty samples of crops, collected several years ago in a study of the relation of pot culture to plot culture, and 16 samples of oats grown in a series of experiments in the study of basic slag, were analyzed.

The study and tabulation of many data in hand completed the year's work.

## CEREAL SECTION.

The cereal section was organized in 1904 with the purpose of collaborating with the Bureau of Plant Industry, principally along the following lines: (1) To improve the quality of wheat grown in this country; (2) to study the effect of varying climatic conditions on newly introduced varieties of grain; and (3) to study the changes in chemical composition which our own wheats undergo when growing in different localities.

More specifically the work of the section is as follows:

(1) The study of the deterioration of wheat, or the production of white spots, thus making the grain less glutenous. This study is being carried on both in greenhouse pot experiments and in the field in connection with the Colorado Experiment Station.

(2) The influence of fertilizers, especially phosphate salts, on the gluten content of wheat. This experiment is being conducted in collaboration with the Tennessee Experiment Station.

(3) The influence of a preceding legume crop on the gluten content of wheat, conducted in collaboration with the California Experiment Station at Modesto.

(4) Several experiments (so-called "triangular experiments") have been begun, the object of which is to grow a sample of grain from the same source at three different points (South Dakota, Colorado, and Tennessee, for example) in successive years, and also to grow a portion of the crop from each point at each of the other two points. These experiments will give a check on the influence of climate and of seed.

(5) The work reported last year on the protein, phosphorus, sulphur, and lecithin content of barley and malt was continued, to determine whether these constituents exert any influence on the quality of the beer produced therefrom.

(6) Experiments are also under way in collaboration with the Tennessee, Kansas, and Nebraska experiment stations, on the influence of the date of planting and the rate of seeding on the composition of cereals.

In carrying out these experiments it is necessary to make determinations of water, ash, phosphoric acid, fat, fiber, pentosans, sugars, gluten, total protein, weight per 1,000 kernels and weight per bushel, etc., and 2,626 such determinations have been made during the past year. In addition to these, 490 samples of food and excreta were examined in connection with a metabolism experiment conducted in feeding phosphorus to rabbits and dogs. The results of this experiment will appear in the *Journal of Biological Chemistry*.

The work on the Swedish Select oat, in cooperation with the office of Grain Investigations of the Bureau of Plant Industry, has been continued. The investigation embraces a study of the feeding value of a large number of samples, mainly of introduced varieties, of grains especially characterized by drought and rust-resistant properties. In addition to the oats the study includes barley, rye, emmer, einkorn, proso, and sorghum. The individual samples number between 500 and 600, and the usual analyses for feeding stuffs are made.

Special research work has also been conducted, including a study of the protein constituents of wheat and flour and other constituents considered in their relation to the keeping properties and aging of flours and the quality and value of bread.

#### LEATHER AND PAPER LABORATORY.

##### TANNING MATERIALS.

The analytical work on Sicilian sumacs was completed about the end of the last calendar year, and as all the calculations have now been made the results are being prepared for publication as rapidly as possible. The results show conclusively that somewhat less than one-half of the samples were more or less adulterated, chiefly with lentiscus, while some were adulterated with sumac stems and other foreign materials. The investigation shows that adulterations may be detected both from the chemical analysis and from microscopic examination. The percentage of tannin and the color of the liquor made from the sumac are essential features of sumac examination from the tanner's point of view.

## LEATHER.

There has been much complaint abroad that our leathers are heavily adulterated and weighted with worthless materials. Publication of these facts has considerably injured our export trade in certain leathers, and samples of these leathers are being collected to determine the truth of the statement as well as to determine whether our leathers are inferior to foreign leathers in this respect.

## PAPERS.

Investigations on book and envelope papers, with particular reference to the needs of the public service, have been conducted during the past year, and it is hoped to complete this work during the current calendar year. A large number of envelopes, postal cards, stamped envelopes, and stamp papers have been examined and analyzed during the year for the Post-Office Department, and assistance has been given in revising the specifications for these classes of paper, so that they are more definite than before and will better secure the interests of the Government—in fact, a marked saving has already resulted from the work along this line.

## WOOD TURPENTINE.

A large number of the wood turpentine plants of the South were inspected and data collected with regard to the yields of the various processes, cost of materials and of operation, availability of raw material, etc. At the same time large samples of turpentine, prepared by the typical processes, were collected, and with the cooperation of two varnish makers varnishes were prepared from these in order to determine the value of wood turpentine for the manufacture of high-grade varnishes. As soon as sufficiently aged these varnishes will be tested practically and in the laboratory and a report of the results prepared. Samples of wood turpentine produced by various processes have also been collected for analysis. A small retort has been installed and different methods of recovering turpentine from wood are studied.

## DESTRUCTIVE DISTILLATION OF WOOD.

The wood-distillation centers of New York and Pennsylvania were visited and information collected with regard to the status and needs of this chemical industry and cooperative experiments arranged to show the yield of valuable products and the quantity of each produced at different periods of the distillation. These experiments are planned to form the foundation for research work looking to the material increase of valuable products now obtained.

## MISCELLANEOUS WORK.

This character of work has occupied a great deal of time during the past year. A number of fertilizers, soils, and other materials were referred to this laboratory from various sources. In addition to this a considerable amount of preliminary work was done in cooperation with other laboratories of the Bureau in making the beers to be used



in experimental work and in organizing the cold-storage investigation under the direct supervision of the Chief of Bureau. The work of the Association of Official Agricultural Chemists and of the American Leather Trade Chemists on tanning materials and fertilizers has been participated in by this laboratory, and much time devoted to the study of methods.

The number and character of samples received in the laboratory during the year are shown in the following table:

Papers .....	450
Tanning materials and leathers.....	50
Turpentine and woods.....	14
Beers .....	83
Miscellaneous .....	47
Total number of samples indexed .....	644

#### MICROCHEMICAL LABORATORY.

As in previous years the work of this laboratory has been conducted chiefly in cooperation with the other laboratories, a total of 1,067 examinations having been made.

In connection with the imported-food work there have been examined in collaboration with the Division of Foods samples of cocoas, mustards, and other spices, as well as a few confections. For the investigations upon fruit, microscopical examinations were made of persimmons and the alligator pear, making a total of 173 examinations.

The microscopical work upon cattle foods begun during the previous year has been completed, 404 examinations having been made for the Miscellaneous Laboratory, and the results will be prepared for publication during the coming year.

In collaboration with the Contracts Laboratory there have been examined carbon papers and typewriter ribbons. In connection with the work of that laboratory for other branches of the Government service, microscopic examinations have been made of a few talcum powders and dextrins, giving a total of 79 examinations.

A large number of imported sumac samples have been examined for the Leather and Paper Laboratory to determine the extent and nature of adulteration. There was also examined a number of paper samples for the Post-Office Department and the Government Printing Office. In fact, the larger part of the work upon papers during the past year has been on samples submitted by the Post-Office Department, and that the work is recognized to be of importance is shown by the fact that the number of samples submitted during this period has greatly increased over that of previous years. In connection with the work upon papers there have been carried on some investigations upon a method for the estimation of the percentages of pulp entering into papers. This involved the making up of a large number of composite pulps which were made the basis of the work. Altogether 248 examinations were made for this laboratory.

In connection with the work of the Drug Laboratory on fraudulent medicinal preparations for the Post-Office Department, 44 samples were examined to determine, by their structural nature, the kinds of material used, especially starches and powdered plant and glandular tissues.

In connection with the investigations of the cereal section the biological analysis of 130 barleys has been made.

The miscellaneous work of the laboratory includes the examination of certain rices, starches, fibers, buckwheat flours, and similar substances. An investigation concerning the identification of cocoa starch in the presence of common adulterants was carried out during the first part of the year. The results are published in the report of the Association of Official Agricultural Chemists for the meeting of 1905.

During the year the chief of the laboratory collaborated in the preparation of the manuscript for Bulletin 100, entitled, "Some Forms of Food Adulteration and Simple Methods for their Detection," which was published in the latter part of the year. The preparation of sets of samples illustrating pure and adulterated food materials, which was begun last year, was completed, and the sets were distributed or loaned to persons and teachers interested in foods and their composition.

There have been prepared during the year 100 photographic negatives, the most of which were photomicrographs, and included additions to the collection of photographs of starch, persimmon tannin cells, plant crystals, and diatoms from agar-agar, besides certain spice photographs.

In October, 1905, a bacteriological chemist was appointed and assigned to the Microchemical Laboratory. The following is a synopsis of the work accomplished since that time, the collection of the apparatus and other equipment for bacteriological work having consumed much time: The laboratory work included the bacteriological examination of 17 samples of water; 31 cans of condensed milk and infant foods; 10 petri plates containing colonies from milk to be identified; testing germicidal value of 17 disinfectants; one-half dozen fresh eggs; 2 cold-storage quail; 1 fresh chicken; 1 specimen watercress; 2 samples imported egg yolk; 1 prickly pear; 2 specimens cold-storage beef; 2 samples ice; 2 samples milk; 1 sample sugar cane; 1 analysis of air; 2 samples beer; 1 liquid peptonized food, and 1 cream puff. Some idea of the amount of work required in making these examinations can be obtained from the fact that more than 200 species of organisms were isolated and identified.

#### CLERICAL WORK.

The amount of clerical work performed in the Bureau during the fiscal year ended June 30, 1906, is summarized as follows:

Approximate number of typewritten letters.....	16, 600
Approximate number of typewritten pages other than letters.....	4, 000
Requisitions .....	1, 226
Accounts audited.....	1, 600

The above tabulation does not include a large number of circular letters, a vast amount of work on the various card catalogues of the Bureau, or the work of receiving and disbursing supplies.

## PUBLICATIONS.

The publications and miscellaneous printing of the Bureau for the fiscal year were as follows:

## NEW PUBLICATIONS.

Bulletins: No. 91, Mineral Waters of the United States, 100 pages; No. 97, Studies on Peaches, 32 pages; No. 98, Drug Legislation in the United States, 217 pages (in press); No. 99, Proceedings of the Twenty-second Annual Convention of the Association of Official Agricultural Chemists, held at Washington, D. C., November 16, 17, and 18, 1905, 211 pages; No. 100, Some Forms of Food Adulteration and Simple Methods for their Detection, 59 pages; No. 69, Parts I-IX, Foods and Food Control, revised to July 1, 1905, 785 pages. Total, 1,408 pages.

Circulars: No. 10, revised, Methods of Analysis of Insecticides and Fungicides, 11 pages; No. 14, revised, Organization of the Bureau of Chemistry, 16 pages; No. 16, revised, Officials Charged with the Enforcement of Food Laws in the United States and Canada (April 1, 1906), 29 pages; No. 19, revised, Methods for the Detection of Renovated Butter, 3 pages; No. 24, Analysis of the Mexican Plant *Tecoma mollis* H. B. K., 6 pages; No. 25, Coloring Matters for Foodstuffs and Methods for their Detection, 40 pages; No. 26, Extracts from the Proceedings of the Association of Official Agricultural Chemists, 1905, 16 pages; No. 27, Cooperative Work on Fats and Oils, A. O. A. C., 1906, 6 pages; No. 28, Provisional Methods for the Determination of Food Preservatives as authorized by the Association of Official Agricultural Chemists, 1905, 13 pages; No. 29, Changes in Provisional Methods for the Analysis of Foods and additions thereto, from 1902 to 1905, 20 pages; No. 30, Changes in Official Methods of Analysis and Additions thereto, 1899 to 1905, 28 pages; No. 17 of the Secretary's Office, Standards of Purity for Food Products, 7 pages. Total, 195 pages.

Food Inspection Decisions: Nos. 26-39, 15 pages.

Articles in 1905 Yearbook: Table Sirups, 10 pages; Formaldehyde, Its Composition and Uses, 6 pages. Total, 16 pages.

Unnumbered circulars: Standard for Honey, 1 page; Outline of A. O. A. C. Work on Drugs, 1905, 3 pages; Tables for Calculating Reduction of Cuprous Oxid to Copper, etc., 2 pages; Tables for Calculating Percentage of Alcohol, 2 pages; Preliminary Report on the Unification of Terms for Reporting Analytical Results, 16 pages; Cooperative Work on the Unification of Terms for the Reporting of Analytical Results, A. O. A. C., 1906, 2 pages; Suggestions to Importers, March 10, 1906, 1 page; Standards of Purity for Food Products, Tentative Draft, May 29, 1906, 4 pages; Outline of Cooperative Work on Drugs, A. O. A. C., 1906, 4 pages. Total, 35 pages.

Total number of pages of original matter prepared for publication, 1,669.

## PUBLICATIONS REPRINTED.

Bulletins: No. 13, Part 10, Preserved Meats; No. 46, revised, Methods of Analysis, etc.; No. 62, Proceedings of the Seventeenth Annual Convention, A. O. A. C., 1900; No. 64, The Influence of Environment upon the Composition of the Sugar Beet, 1900; No. 65,



Provisional Methods for the Analysis of Food (2); No. 66, Fruits and Fruit Products, Chemical and Microscopical Examination; No. 69, Parts I to VIII, Foods and Food Control; No. 71, A Study of Cider Making in France, Germany, and England, etc.; No. 73, Proceedings of the Nineteenth Annual Convention, A. O. A. C., 1902; No. 74, The Influence of Soil and Climate upon the Composition of the Sugar Beet, 1901; No. 78, The Influence of Environment upon the Composition of the Sugar Beet, Including a Study of Irrigated Sections, 1902; No. 80, Adulterated Drugs and Chemicals; No. 81, Proceedings of the Twentieth Annual Convention, A. O. A. C., 1903; No. 82, Paris Green Spraying Experiments; No. 84, Part I, Influence of Food Preservatives and Artificial Colors on Digestion and Health: I, Boric Acid and Borax; No. 88, The Chemical Composition of Apples and Cider; No. 90, Proceedings of the Twenty-first Annual Convention, A. O. A. C., 1904; No. 92, The Effect of Water on Rock Powders; No. 93, Experiments in the Culture of Sugar Cane and Its Manufacture into Table Sirup (2); No. 95, The Influence of Environment upon the Composition of the Sugar Beet, 1903; No. 96, The Influence of Environment upon the Composition of the Sugar Beet, 1904, etc. Total number of pages in bulletins reprinted, 3,376.

Circulars: No. 15, Results of Borax Experiment (2); No. 22, Cooperative Work on the Titer Test, etc.; No. 23, Methods for the Examination of Maple Products. Total number of pages, 78.

Food Inspection Decisions: Nos. 1-25; No. 26 (2); Nos. 27-32. Total number of pages, 39.

Miscellaneous: Detection of Cottonseed Oil in Lard (Yearbook, 1904); Table Sirups (Yearbook, 1905); Formaldehyde, Its Composition and Uses (Yearbook, 1905); Report on Soils, from Bulletin 90; Testimony before the Interstate Commerce Committee of the House of Representatives; Report on Insecticides, etc., from Bulletin 99; Report of the Chemist, 1905. Total, 478 pages.

Total number of pages reprinted, 3,971.

#### JOB PRINTING.

A total of 216 requisitions, distributed approximately as follows:

Miscellaneous (forms for time clerk, property clerk, and librarian, notices, etc.), 46; drawings and blueprints, 32; index cards, 17; labels, 19; books of food-inspection forms, 5; circular letters, 43; stationery (envelopes and franks), 22; letter heads, 32.

#### WORK OUTLINED FOR THE FISCAL YEAR ENDING JUNE 30, 1907.

##### DIVISION OF FOODS.

The study of the influence of preservatives and coloring matters on nutrition and health will be continued. If this work is conducted on the same scale as in the past it will require the entire time of seven men in addition to those engaged on the determination of nitrogen. The study of the effect of cold storage upon the healthfulness of foods will be continued.

A study of the ripening of fruit will be continued, special attention being given during the early part of the year to the manufacture of cider. During the latter part of the year it is hoped to work entirely on several varieties of tropical and subtropical fruits.

A study of the manufacture of vinegar will be continued, special attention being given to the manufacture of malt vinegar. Some attention will also be given to the standards of composition for vinegar, a number of samples of known origin being examined for that purpose.

A large amount of analytical work for the purpose of determining the standards of composition of other foods will be necessary. A comparative study of methods for the investigation of foods and the elaboration of new methods will be continued.

A large part of the attention of the division will be given to the enforcement of the imported-food law. The laboratories at the ports of New York and Philadelphia will be greatly enlarged during the year, and the number of employees in those laboratories will be correspondingly increased. The efficiency of the inspection will therefore be improved, and the number of samples examined will be greater than it has been in the past.

A most important part of the work of the Division of Foods during the fiscal year ending June 30, 1907, will be in connection with the enforcement of the food and drugs act, passed June 30, 1906, and taking effect on January 1, 1907. The laboratories now engaged in the inspection of imported foods will also give attention to the examination of foods inspected under the food and drugs act. In addition to this, as far as possible, arrangements will be made with the dairy and food departments of the respective States for collaboration in the enforcement of the act.

#### SUGAR LABORATORY.

The following lines of work are contemplated for the current year:

1. A continuation of the cooperative work with the Association of Official Agricultural Chemists along the following lines, the chief of laboratory acting as the referee on sugar.

- (a) A study of commercial methods for sugar and molasses analysis; also an investigation of bleaching agents for molasses.

- (b) A study of methods for the determination of caramel, organic acids, and other nonsugar constituents of cane and beet products.

- (c) A study of special methods used for the investigation of carbohydrates in general.

2. An investigation of malts and malt products. This investigation is to embrace a study of the nature and composition of the various malted products found in the market, including such preparations as the various malt extracts used for brewing or for medicinal purposes, malted breakfast foods (as malta vita, malted rice, etc.), malted milks, malted cocoas and chocolates, etc. This research will necessitate considerable investigation not only of methods of analysis, but also as to the character of the hydrolytic effect produced by malts upon different starches under the varying conditions of temperature, restriction, and concentration.

3. An investigation of the economic production of alcohol from various raw materials, such as cornstalks, wood refuse, molasses, sweet potatoes, etc. This research will not only take up the composition of the various products mentioned, but will also include a study of the methods of hydrolysis, fermentation, and distillation.

4. An investigation of the various denaturants of alcohol and their special application in denaturing.

5. It is also hoped that a somewhat extensive investigation may be made regarding the character of the various carbohydrate bodies, classified under the head of nitrogen-free extract, in a variety of less commonly studied plant products, this investigation to be carried on as the more urgent work of the laboratory permits. Among the materials to be investigated in connection with this investigation might be mentioned certain mushrooms, kelp, and other human foods of similar nature; mesquite pods, carob beans, and other less commonly studied cattle foods; the different plant gums, and commercial products of a similar nature.

6. In addition there will be a varying amount of miscellaneous work to be done in connection with the work of the food, drug, and other laboratories of the Bureau.

The study of the influence of environment on the sugar content of sweet corn in cooperation with various experiment stations will be continued.

#### DAIRY LABORATORY.

The work of the Dairy Laboratory during the current year will be as follows:

1. Continuation of work for the Dairy Division, Bureau of Animal Industry, in the examination of samples collected by that Bureau in its work of enforcing the renovated-butter law and of investigating the composition of American butters.

2. Analysis of dairy products and dairy materials in connection with the food investigations of this Bureau as heretofore.

3. Miscellaneous analyses of dairy products for other Departments of the Government as heretofore.

4. Practical trial in creameries and renovating factories of the rapid method of determining water in butters, mentioned above, to test its applicability and usefulness as an aid in controlling the water content of the butters produced.

5. Continuation of cooperative work with the Dairy Division, Bureau of Animal Industry, upon the composition and digestibility of Cheddar cheese, made in different ways and ripened at different temperatures.

#### MISCELLANEOUS LABORATORY.

During the year ending June 30, 1907, the examination of irrigation waters for the Office of Irrigation and Drainage Investigations will be continued, and according to present indications the work will be greatly increased.

The composition of American mineral waters will be further studied, giving special attention to these waters as they come from the ground, rather than as they appear on the market. This investigation will be carried on in collaboration with the Hydrographic Office of the United States Geological Survey.

Work on sanitary water analysis will be continued, and in special cases studies of the water supply of towns too small to employ a chemist will be undertaken.

The work on insecticides in collaboration with the Bureau of Entomology will be continued and a study will be made of the composition of samples of lead arsenate and the ingredients for making it, as they are sold on the American market. This last investigation will also



include field studies in collaboration with the Bureau of Entomology to determine the cause of injury to fruit and foliage by certain samples of lead arsenate. The results obtained in the studies of the lime-sulphur-salt wash and methods of analysis of lead arsenate will be published.

A study of the methods of determining various constituents in the common disinfectants will be undertaken in the hope of improving the same.

The work on the composition of American cattle foods already completed will be collated and published, and further work on this subject will be undertaken. Considerable time will be spent in studying the composition of forage crops of the arid and semiarid West in collaboration with the office of Farm Management. The analysis of malts and barleys will be continued.

Work on the effects of trade wastes on agriculture will be continued and an investigation of the effect of the constituents of the dump heap from copper smelters on various farm crops will be undertaken. In connection with this study an investigation will also be made of the amount of toxic elements absorbed by various crops which are irrigated with waters containing such toxic elements.

If time allows, certain hygienic studies will be undertaken similar to those previously published from this laboratory on arsenic in papers and fabrics. It is also hoped that an investigation will be started during the year on the analysis and adulteration of paints.

#### DRUG LABORATORY.

The work planned for the current year is a continuation of the investigations instituted in this laboratory and given in detail in the report of work for the fiscal year ended June 30, 1906. To this must now be added the work which devolves upon this laboratory when the food and drugs act goes into effect January 1, 1907, which will include examinations of all substances intended to be used for the cure, mitigation, and prevention of diseases, both internally and externally. The work can be briefly summarized as follows:

**CHEMICAL REAGENTS.**—Examination of chemical reagents in the Bureau of Chemistry for the purpose of collecting data for standards and insuring the securing of reliable chemicals for analytical work.

**PLANT DRUGS.**—Study of quality, purity, and keeping qualities, and an examination of the analytical methods at present in use.

**COD-LIVER-OIL INVESTIGATION.**—Investigation of cod-liver oils with a view of determining in what manner the American oils differ from the Norwegian, and, if they differ, what the causes of such differences are and how they may be eliminated.

**PROPRIETARY MEDICINAL REMEDIES.**—Examination of these remedies so as to supply the Post-Office Department with the desired information relative to fraudulent medicines; to cooperate with the American Medical Association, and to supply recognized officials with proper data.

The examination of these remedies, in view of the recent Federal pure-drug legislation, must include not only those referred to above, but also medicinal compounds which must comply with the law recently enacted.

**PLANT ANALYSIS.**—This line of work has for its object the determination of the medicinal value of indigenous plants which are represented as having great curative properties.

**DRUGS.**—The food and drugs act specifies that the Bureau of Chemistry shall make examinations of drugs, which term includes all those not of a proprietary nature referred to above.

#### CONTRACTS LABORATORY.

The work for the fiscal year ending June 30, 1907, will be along the same general lines as that for the past year. It has been the policy of this laboratory to take up as far as possible work desired by the various Executive Departments. It was in this way that the work on inks and typewriter ribbons was undertaken. While these investigations have been published, it is probable that more work will be required on these subjects. An investigation of carbon papers is now in progress, and it is proposed to continue this. Also, at the request of the Treasury Department, a study of methods of determining zinc silicate and carbonate in ores has been begun, which will probably occupy some time. The work on determination of reducing sugars will also be continued. It is proposed to take up the examination of other supplies purchased by the Government, and, while the selection of subjects may be largely influenced by the demands of other Departments, a study of paints and varnishes is contemplated.

#### PLANT ANALYSIS LABORATORY.

It is planned to continue the studies in cassava, with special reference to fertilization tests, cultural methods, and the practical utilization of the product in a study of sizing material, cattle food, and alcohol manufacture. To this end a series of field tests on the fertilization of different varieties has been planned, the work to be done in collaboration with the Bureau of Plant Industry.

A second study in collaboration with the Bureau of Plant Industry will be undertaken in the investigation of the cotton plant. This will comprise the examination of several hundred samples, which constitute a series of plant-breeding experiments. The chemical investigation is to be made upon the seed with regard to the variation in composition between different varieties and the same variations in their successive offspring grown under different conditions of climatic environment.

In collaboration with the same Bureau a similar study of forage plants has been arranged. For this experiment 74 samples of different varieties of grasses and their offspring will be studied with reference to alkali-resisting qualities.

#### CEREAL SECTION.

The following investigations will be continued in cooperation with the Bureau of Plant Industry:

1. The effect of various fertilizers on the quality of grains; plant experiments conducted at various experiment stations.
2. The effect of environment on the gluten content of durum wheats.

3. The feeding value of the Swedish Select oat and other grains.

4. The study of the protein and other constituents of wheat and flour with relation to the aging of flour and the quality of bread.

It is also planned to inaugurate other experiments in connection with the Bureau of Plant Industry and the experiment stations for the purpose of studying the influence of climate and soils on the composition of grains and the changes in protein and other constituents during the growing period.

#### LEATHER AND PAPER LABORATORY.

The following lines of work are planned for the Leather and Paper Laboratory:

A continuation of the investigation of tanning materials with reference to the suitability of such products as are quick-growing or which have been hitherto but little used, with a view to supplementing the rapidly decreasing supply of material now generally used.

The investigation and valuation of degreas, or wool grease, and of various methods for the detection of its adulterants.

The investigation of the physical and chemical qualities of various leathers.

The investigation of the principles of rapid tanning.

A continuation of the investigation of papers for various uses, and the preparation of standard specifications for such papers.

The investigation of new raw material for pulp and paper making and the demonstration of the value of such material.

The continuation of the investigation of the production and industrial application of wood turpentine.

The investigation of the adulterants of turpentine.

A continuation of the study of the destructive distillation of woods, with particular reference to increasing the yields of products.

This laboratory will also cooperate, so far as its facilities will permit, with other bureaus and divisions of this and other Departments in work which comes within its province.

#### MICROCHEMICAL LABORATORY.

Arrangements are being made to extend the work on foods and drugs in order to meet the increased demands entailed by the food and drugs act, June 30, 1906. Especial attention will be paid to the microscopic examination of drug materials.

The work on bacteriological problems, especially those relating to the storage and preservation of foods, will be continued under the direct supervision of the Chief of Bureau.

The work begun last year upon barleys and malts will be continued and probably completed.

These special lines of investigation, together with the routine work incident to the examination of miscellaneous samples and the experiments conducted by other laboratories, will complete the work of this laboratory.





## REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., September 20, 1906.*

SIR: I have the honor to transmit herewith a report upon the work of the Bureau of Soils for the fiscal year ended June 30, 1906. During the year the most notable achievements of the Bureau have been the survey of an additional 19,341 square miles of territory, making the total area surveyed to date of 118,687 square miles, or 75,959,680 acres; the reaching by the laboratories of a point in their investigations where the nature of the soil is now for the first time well understood; where the cause of the low yield of crops can be determined, and the manurial requirements of soils can be found in ten days or two weeks by a simple method which can be used by farmers; the practical completing of the work on the five alkali reclamation tracts that have been under investigation for the past five years, as a result of which the Bureau can now reclaim at an economical cost any area of any alkali soil in an irrigated district where suitable drainage outlets can be secured; and the demonstration beyond question that a superior and satisfactory wrapper leaf of the Sumatra type can be produced in the Connecticut Valley, and that a filler closely resembling the Cuban leaf and pronounced by the trade to be not only satisfactory, but superior to any domestic leaf previously grown in this country, can be produced on certain soils in Texas and Alabama. The details of this will be found in the accompanying report.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

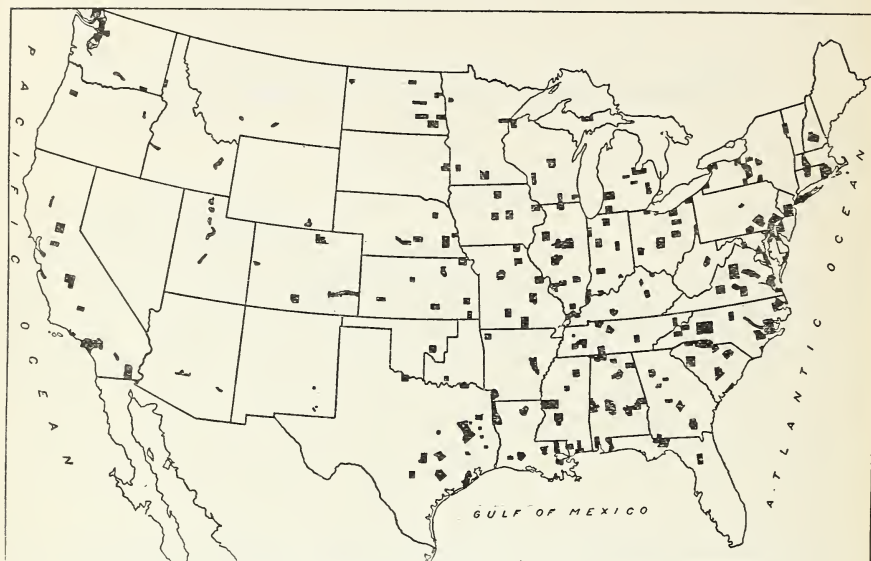
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### PROGRESS OF THE SOIL SURVEY.

The area surveyed and mapped during the fiscal year was 19,341 square miles, or 12,378,240 acres. The area surveyed during the preceding fiscal year was 24,613 square miles, and there have been completed to June 30, 1906, surveys covering a total of 118,687 square miles, or 75,959,680 acres. These areas have been so distributed that some work has been done in all but two States and in all of the Territories except Alaska and Hawaii.

Work was undertaken during the fiscal year ended June 30, 1906, in forty-three areas, distributed through twenty-nine States and two

Territories. From fifteen to seventeen parties have been kept in the field continually, and these parties have been so distributed that all field work in the South Atlantic or Gulf States has been done



Areas covered by the soil survey to July 1, 1966.

during the winter months and in the more northern States during the summer months.

The areas surveyed and their respective costs are given in the following tables:

*Areas surveyed and mapped during the fiscal year ended June 30, 1966, and the areas previously reported.*

State or Territory.	Area surveyed during 1966.	Areas previously reported.	Total area surveyed.	
	Sq. miles.	Sq. miles.	Sq. miles.	Acres.
Alabama .....	629	6,863	7,492	4,794,880
Arizona .....		611	611	391,040
Arkansas .....	736	877	1,613	1,032,320
California .....	144	6,335	6,479	4,146,560
Colorado .....	78	2,350	2,428	1,553,920
Connecticut .....		518	518	331,520
Delaware .....		314	314	200,960
Florida .....	680	1,708	2,388	1,528,320
Georgia .....	609	1,813	2,422	1,550,080
Idaho .....		1,135	1,135	726,400
Illinois .....		5,925	5,925	3,792,000
Indiana .....	887	2,036	2,923	1,870,720
Indian Territory .....	440		440	281,600
Iowa .....		2,303	2,303	1,473,920
Kansas .....	389	2,345	2,734	1,749,760
Kentucky .....	679	1,370	2,049	1,311,360
Louisiana .....	825	3,568	4,393	2,811,520
Maryland .....		2,663	2,663	1,704,320
Massachusetts .....		796	796	509,440
Michigan .....	460	3,078	3,538	2,264,320
Minnesota .....	578	486	1,064	680,960
Mississippi .....	903	2,902	3,805	2,435,200
Missouri .....	787	3,783	4,570	2,924,800
Montana .....	325	107	432	276,480
Nebraska .....	527	1,561	2,088	1,336,320
New Hampshire .....	200		200	128,000



*Areas surveyed and mapped, etc.—Continued.*

State or Territory.	Area surveyed during 1906.	Areas previously reported.	Total area surveyed.	
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Acres.</i>
New Jersey .....		1,303	1,303	833,920
New Mexico .....		129	129	82,560
New York .....	600	3,280	3,880	2,483,200
North Carolina .....	360	6,618	6,978	4,465,920
North Dakota .....	865	1,825	2,690	1,721,600
Ohio .....	685	3,055	3,740	2,393,600
Oklahoma .....	720		720	460,800
Oregon .....		446	446	285,440
Pennsylvania .....	1,016	1,978	2,994	1,916,160
Porto Rico .....		330	330	211,200
Rhode Island .....		1,085	1,085	694,400
South Carolina .....	655	4,002	4,657	2,980,480
South Dakota .....		485	485	310,400
Tennessee .....	597	3,046	3,643	2,351,520
Texas .....	1,441	7,479	8,920	5,708,800
Utah .....		1,501	1,501	960,640
Vermont .....		227	227	145,280
Virginia .....	740	4,276	5,016	3,210,240
Washington .....	588	680	1,268	811,520
West Virginia .....	330	254	584	373,760
Wisconsin .....	868	1,591	2,459	1,573,760
Wyoming .....		309	309	197,760
Total .....	19,341	99,346	118,687	75,959,680

*Areas surveyed and mapped and cost of field work during the fiscal year ended June 30, 1906.<sup>a</sup>*

State or Territory.	Area.	Area surveyed.	Cost per square mile.	Total cost.
		<i>Sq. miles.</i>		
Alabama .....	Lee County .....	629	\$2.67	\$1,680.44
Arkansas .....	Fayetteville .....	161	3.25	523.67
Do .....	Prairie County .....	575	3.84	2,206.41
California .....	Redbluff .....	144	5.53	796.39
Colorado .....	Grand Junction <sup>b</sup> .....	78	6.88	533.94
Florida .....	Escambia County .....	680	3.52	2,391.31
Georgia .....	Waycross .....	609	2.61	1,590.59
Indiana .....	Greene County .....	310	2.25	698.17
Do .....	Newton County <sup>b</sup> .....	78	3.84	299.23
Do .....	Tippecanoe County .....	499	2.25	1,125.08
Indian Territory .....	Tishomingo .....	440	3.07	1,350.16
Kansas .....	Brown County <sup>b</sup> .....	195	2.02	393.97
Do .....	Riley County .....	194	2.97	576.39
Kentucky .....	McCracken County .....	242	2.45	594.36
Do .....	Madison County .....	437	1.99	868.40
Louisiana .....	Caddo Parish .....	825	3.56	2,936.24
Michigan .....	Cass County .....	250	1.42	354.02
Do .....	Oxford .....	210	4.43	929.00
Minnesota .....	Blue Earth County .....	220	2.80	615.45
Do .....	Carlton <sup>b</sup> .....	183	2.79	510.36
Do .....	Crookston .....	175	2.53	442.63
Mississippi .....	Montgomery County .....	405	4.09	1,655.61
Do .....	Pontotoc .....	498	2.85	1,421.32
Missouri .....	Crawford County <sup>b</sup> .....	347	2.07	719.37
Do .....	Scotland County .....	440	1.83	805.65
Montana .....	Gallatin Valley .....	325	4.24	1,378.86
Nebraska .....	Lancaster County .....	300	1.65	495.75
Do .....	Sarpy County .....	227	2.76	626.17
New Hampshire .....	Merrimack County .....	200	2.99	597.43
New York .....	Binghamton .....	229	1.82	417.28
Do .....	Madison County .....	270	1.82	492.23
Do .....	Niagara County .....	8	8.33	66.67
Do .....	Tompkins County <sup>b</sup> .....	93	4.82	446.16
North Carolina .....	Chowan County <sup>c</sup> .....	161	3.29	529.87
Do .....	New Hanover County .....	199	3.73	743.19

<sup>a</sup> This includes the salaries of the men while in the area and their subsistence expenses, but not cost of transportation to and from the area.

<sup>b</sup> The portions of these areas surveyed in the preceding fiscal year were given in the last report.

<sup>c</sup> Of this amount \$188.10 was paid by the North Carolina Department of Agriculture.

*Areas surveyed and mapped and cost of field work, etc.—Continued.*

State or Territory.	Area.	Area surveyed.	Cost per square mile.	Total cost.
		<i>Sq. miles.</i>		
North Dakota .....	Carrington <i>a b</i> .....	420	\$2.27	\$951.83
Do.....	Ransom County <i>c</i> .....	200	2.16	431.82
Do.....	Williston <i>d</i> .....	245	2.59	635.47
Ohio.....	Cleveland.....	509	2.51	1,280.88
Do.....	Westerville <i>a</i> .....	176	1.87	241.24
Oklahoma.....	Oklahoma County .....	720	2.59	1,862.97
Pennsylvania .....	Chester County .....	760	2.29	1,736.94
Do.....	Montgomery County <i>a</i> .....	256	3.79	970.27
South Carolina .....	Cherokee County .....	361	1.41	507.65
Do.....	York County <i>a</i> .....	294	2.17	637.55
Tennessee.....	Henderson County <i>a</i> .....	214	2.57	549.34
Do.....	Madison County .....	383	1.84	706.20
Texas.....	Henderson.....	500	3.53	1,766.85
Do.....	Lee County <i>a</i> .....	426	1.92	819.04
Do.....	San Marcos .....	515	3.00	1,545.03
Virginia.....	Hanover County.....	475	2.43	1,154.35
Do.....	Louisa County <i>a</i> .....	265	1.97	521.40
Washington.....	Everett .....	525	3.02	1,583.92
Do.....	Island County <i>a</i> .....	63	1.46	91.75
West Virginia .....	Upshur County <i>a</i> .....	115	2.96	340.96
Do.....	Wheeling .....	215	2.65	570.42
Wisconsin.....	Portage County.....	620	2.14	1,326.50
Do.....	Racine County.....	248	2.54	628.73
Total.....	.....	19,341	2.72	\$52,672.88

*a* The portions of these areas surveyed in the preceding fiscal year were given in the last report.

*b* Of this amount \$230.94 was paid by the Agricultural and Economic Geological Survey of North Dakota.

*c* Of this amount \$111.02 was paid by the Agricultural and Economic Geological Survey of North Dakota.

*d* Of this amount \$169.41 was paid by the Agricultural and Economic Geological Survey of North Dakota.

## RECAPITULATION OF SOIL SURVEY WORK FOR THE FISCAL YEAR 1906.

Cost of field work.....	\$52,672.88
Supplies and other expenses.....	710.75
Traveling expenses between areas.....	2,177.50
Total cost of soil survey.....	55,561.13
Paid by State organizations.....	699.47
Paid by Department of Agriculture.....	54,861.66
Area surveyed, square miles.....	19,341
Cost of work in field per square mile.....	\$2.72
Transportation, supplies, and other expenses per square mile.....	\$0.15
Average total cost per square mile.....	\$2.87
Average cost to Department of Agriculture per square mile.....	\$2.84

The cost of the field work has increased from \$2.59 per square mile, as reported last year, to \$2.72 for the fiscal year just closed. The total cost per square mile to the Department for both the field and office work connected with the survey, and including transportation between areas and all supplies, has increased from \$2.78 per square mile, as reported in 1905, to \$2.84 per square mile for the last year.

It will be noted that the cost of the soil-survey work was decreased from \$68,447.83 in 1905 to \$54,861.66 during 1906. This corresponds to a decrease in the amount of money allotted to the survey work, made necessary because of a decrease in the appropriation available for this work, and also because of a slight decrease in the number of men employed upon the work. The decrease in the area covered—from 24,613 square miles in 1905 to 19,341 square miles in 1906—is almost an exact measure of this decrease in the amount of appropriation for the work.

The demand for soil-survey work in the various States has increased rather than decreased during the year, and the systematic demand for entire regions rather than for counties, to the end that particular areas of certain soil types, such as those of the Orangeburg and Houston series, should be outlined for the purpose of furnishing a basis for the introduction of new crops, forms a new phase in the character of these requests for surveys. The assignment of field parties has been made with this point in view, and extensive studies of the series mentioned have been made in eastern Texas, northern Louisiana, and central Alabama. In the same way, the assignment of parties in the more northern areas has also followed the lines of certain definite soil problems.

It has been recognized for some time that the sugar-beet industry of the United States has reached probably its greatest development in the southern peninsula of Michigan. A study of the soils in this region has shown that within the climatic belt suitable for beet production the soils of the Clyde series, together with one or two types in the Miami and Marshall series, are best fitted for the production of this crop. The extension of the work along this line of investigation of sugar-beet soils has called for several surveys in northern Indiana, in Illinois, in Wisconsin, and in Minnesota.

The study of the fruit soils of the United States has similarly constituted another problem not so narrowly confined to given localities. Work along this line has been pursued in New England, New York, Pennsylvania, Missouri, Arkansas, and Texas. The problem of the proper adaptation of the various soils to the different fruit crops is becoming of greater importance with the increase of horticultural industry in the United States.

The study of tobacco soils has been carried on in Virginia, North Carolina, Georgia, Florida, Alabama, Louisiana, and Texas. There is possibly no crop which, in the quality and quantity of the finished product, shows so close a relationship to the kind of soil upon which it is grown as tobacco.

The study of the soils adapted to the great cereal crops has been taken up in nearly all of the reports written during the fiscal year. In addition, extensive studies of the cotton soils, particularly of the Gulf States were made. Studies of rice soils in Louisiana and Arkansas also constituted a portion of the year's work. The agricultural development of areas formerly forested, but now being utilized for farming, was taken up, particularly in Georgia, Florida, Wisconsin, Minnesota, and Washington. Studies of undrained lands and of those which are being drained and adapted to agricultural uses were made in several States.

The work in connection with the irrigated areas of the arid and semiarid regions comprise surveys in North Dakota, Colorado, Montana, and California. In each of these States, in addition to the usual soil-survey map, a map showing the present condition of the soils with respect to alkali accumulations was also made.

In the case of the majority of the areas undertaken in 1906 samples of the chief soil types were collected for the determination of the fertilizer or the manurial requirements of the soils. This work was undertaken at the Bureau, and the results obtained by the growth of plants in paraffined wire-net pots, in which different kinds and



quantities of manure and fertilizers were applied to the soils, will be published in these reports. In many of the cases the agreement of the results thus obtained and those secured by the best field practice of the region is marked. This work is being extended and the results obtained by these tests will be given in the case of all soils tested in the succeeding areas.

During the fiscal year ended June 30, 1906, the soil survey lost four field men by resignation and two by transfer to other lines of work in the Bureau. Two additional men were similarly secured by transfer, and eight new men were appointed from the list of eligibles. On June 30 the office force of the survey consisted of three men in charge of various lines of work which required their presence at headquarters; of two men in charge of special field work; of one man assigned to give instruction at an educational institution; of one man assigned to make large-scale surveys of experiment farms; of four men assigned to special temporary duties at headquarters; and of thirty-one men actively engaged in areal surveys. These men were so distributed that work was being carried on by twelve parties of two men each, by one party of three men, and by four parties of one man each. Assistants were being furnished by State organizations in the case of three of these last parties. Work in seventeen areas located in fourteen States was being carried on, and assignments to two additional areas, one in a State in which no survey has as yet been undertaken, had been made.

#### SUMMARY OF THE RESULTS OF THE SOIL SURVEY.

During the fiscal year 1906 survey work was finished in 15 areas which had been begun in 1905, work was undertaken and completed in 26 areas, and work was begun and is now in progress and nearing completion in 17 additional areas.

#### ALABAMA.

In Alabama three areas begun in 1905 were finished and an additional area was worked. This last area was Lee County, in which the agricultural experimental station is located. In addition to the survey of the county on the usual scale, a map was made of the experiment farm on a scale of 1 square inch to the acre. This map will serve as a basis for further experimental studies of the soils of Alabama on the part of the station, and was made for this purpose at the request of the station authorities.

#### ARKANSAS.

In Arkansas the survey of an important area in the center of the State was made in the interest of the recently introduced rice crop. This survey shows a close relationship of the soils of the region to those of the better-known prairies of Louisiana and Texas. Already some profitable crops of rice have been harvested, and the survey will enable those desirous of engaging in this form of agriculture to begin rice growing upon the soils most likely to give success.

An area in the Ozark apple region was taken up in the summer of 1906 for the purpose of studying the soil conditions most suitable for

the production of apples and other fruits. It is found that the soils in general belong to the types already described in other parts of the Ozark region. Besides apples, quite an extensive trade in berries has sprung up around Fayetteville. Strawberries are shipped to the more northern cities and some other berries are also produced.

## CALIFORNIA.

The Stockton area in California was completed and a very important survey in the Sacramento Valley is now in progress. This area is located in the upper Sacramento Valley and includes large tracts of former dry-farmed wheat lands, which are now to be broken up into smaller areas and placed under irrigation for the production of fruits and other intensively farmed crops. In this connection the survey is of the greatest importance in that it furnishes a means for the direct comparison of the soils of the area surveyed with soils already used for fruit culture in other parts of California. Some of the lands of this area consist of the debris and washings from the old placer and hydraulic mines of the foothills, and the report will discuss the possibility of utilizing these lands for agricultural purposes. In addition there are also found some areas of lands subject to temporary overflow, whose proper protection will form one of the problems of the near future. Some of these lands are known to be affected with alkali, and an alkali map will accompany the soil-survey report.

## COLORADO.

The important fruit area around Grand Junction, Colo., was surveyed in 1906. In this area lands are held at high values on account of their demonstrated ability to produce fruit of good quality. There are other undeveloped fruit areas in this and adjoining States which will derive benefit from the study of these soils. Near Grand Junction the question of the control of alkali is presented, and it is thought that the survey work might well be followed by work demonstrating the best methods for alkali control.

## FLORIDA.

The survey of Escambia County, Fla., showed a variety of soils, the majority of which are just passing from a stage of forestation to that of agricultural occupation. Cotton has been raised in the northern part of the county only for about three years, and few other crops are grown. Near the coast there are soils well adapted to the production of truck crops, while the soils of the central and northern part of the county can be made valuable for the production of cotton, cane, corn, and some of the forage crops suited to the climate. Considerable land is still in forest, but is being rapidly cleared and will soon be offered for farming purposes.

## GEORGIA.

An area around Waycross, Ga., is likewise passing from a timber and turpentine producing country to one available for agriculture. Here not only can the long-staple cotton be produced, but many

kinds of fruits and vegetables could be produced for the northern market. Sugar cane is grown, and a superior quality of sirup is made from it.

## INDIANA.

Newton County was described in the last annual report. In addition, Tippecanoe County was surveyed in 1906. This area is devoted to general farming and stock raising. Though a variety of soils exists, they consist chiefly of the Marshall series. Corn is the chief product, though large areas of oats are sown. More and more of the grain is being shipped out of the county, and a proper care for the maintenance of the producing capacity of the soil would suggest the desirability of the introduction of dairying and the feeding of the crops produced. It is also true that a considerably greater variety of crops might be grown on the diverse soils of the area.

## INDIAN TERRITORY.

Soil survey work in the Indian Territory was begun with a survey around Tishomingo in 1906. The lands of this district have recently been divided up in severalty and are being sought for the production of cotton, corn, and alfalfa. The uplands are also found to constitute good fruit soils, and apples and peaches are being planted quite extensively. Thus far little attention has been paid to crop rotation. With the range of crops suited to the soils and the climate of the area, little difficulty should be experienced in working out rotations that will long preserve the fertility of these soils and at the same time give profitable returns.

## KANSAS.

The survey of Brown County, Kans., was completed in 1906 and one in Riley County was begun. This area will include the lands of the State experiment station and a special large-scale map of the experiment farm will also be prepared, as has been done in Alabama. This work was undertaken at the request of the officers of the State university and will be followed by additional research work on their part.

## KENTUCKY.

In Kentucky a survey of McCracken County was made. Tobacco is the principal money crop of the county, and only a few farmers are now practicing any great diversification in their methods. The introduction of dairying for the supplying of the trade in Paducah has been begun, and additional dairy and stock interests would benefit the soils and the community.

In Madison County the agricultural interests are fairly diverse, and corn, wheat, hemp, grass, and other forage crops sustain a well-developed agriculture. One of the great problems of this area is the proper prevention of the destructive erosion of some of the soil types. This can be accomplished in some cases by deeper plowing and the growing of forage and pasture crops on the steeper slopes.



## LOUISIANA.

A survey of Caddo Parish was made to ascertain if any of the soils upon which filler tobacco can be grown existed in this region, as in some of the near-by counties of northeastern Texas. It was found that some of the soils of the Orangeburg series were developed in Caddo Parish and that upon these types, whose area and distribution are shown, tobacco may well be introduced. There are also good cotton and corn soils in the area, and upon some of the types alfalfa may be grown. There is thus quite an opportunity for further diversification in the farm practice of Caddo Parish.

## MICHIGAN.

In Michigan the Oxford area was surveyed. It lies north of the Oakland area and constitutes an extension of the work in that county. A survey of Cass County is now in progress.

## MINNESOTA.

A survey was made of the "cut-over pine lands" in Carlton County, Minn. In this region there exist large areas of land from which the timber growths have been removed, and these are just coming to be used for agricultural purposes. A variety of soil types was encountered, and upon these the production of grass, oats, potatoes, and garden vegetables has been begun. The region promises well as a farming community in which the production of many crops suited to the climate may be successfully undertaken.

During the summer of 1906 surveys are being taken up in the vicinity of Crookston and in Blue Earth County. In the former area the chief problem is that of the proper drainage and reclamation of certain marsh lands and the production of crops adapted to them. A small amount of alkali occurring in these undrained lands may be expected to disappear upon the proper drainage of the swampy areas.

In Blue Earth County the chief problem is a further diversification of crops and the introduction of such crop rotations as will favor the maintenance of crop yields. The soils are in general those of the north-central prairie belt, upon which corn, wheat, oats, and clover are successfully grown. The area lies just to the northward of important dairying and stock-raising sections, and these industries are already being developed. Some attempt has been made to introduce sugar-beet culture in the county. The presence of considerable areas of the Miami black clay loam in the county would lead to the belief that, given proper labor conditions, this might well be accomplished.

## MISSISSIPPI.

In Mississippi soil surveys have been made in Montgomery and Pontotoc counties. In the former county the chief industry is now cotton production, but the diversity of soils would point out the practicability of a much greater diversification of crops. Some of the soils of the area are well suited to vegetables and fruit production for the northern market, and several of the soils are also suited to

growing forage crops for stock feeding. In Pontotoc County the soils of the Pontotoc Ridge are well suited to the growing of peaches and a beginning has already been made. The further development of fruit culture should be upon the soils of the Orangeburg series. There are also considerable areas of timbered and other partially occupied lands existing in the county which are awaiting development.

#### MISSOURI.

In Missouri a survey was made of Crawford County. Apple growing is becoming an important industry in this county and the extension of the industry is possible.

A survey was also made of Scotland County, situated in the prairie region of northern Missouri. Here the chief interest is that of general farming and stock raising.

#### MONTANA.

The soils of the Gallatin Valley were surveyed in Montana. This is the largest tract under irrigation in the State. While injury to vegetation caused by alkali is at present of only relatively small extent, the problem of the control of harmful quantities of these salts is one of increasing importance. Stock raising and dairying are of considerable importance in the area, and these interests, together with the culture of hardy fruits and late vegetables, are capable of considerable extension. Sugar-beet culture is also recommended.

#### NEBRASKA.

The soil survey of Sarpy County, Nebr., was completed and the survey of Lancaster County begun. Sarpy County, on account of its location near Omaha, is becoming a region of somewhat specialized farming. In addition to the dairy products furnished the city trade, vegetables are being grown and the older practice of grain farming and stock raising is becoming modified.

#### NEW HAMPSHIRE.

The survey of Merrimac County, N. H., was begun in 1906 in order to study the soil conditions in some of the older communities where grain production in competition with the prairie regions is no longer profitable. Some of the lands of the region are well suited to the production of fruits and vegetables for near-by city markets, though these crops are frequently brought into the region from the city. Some of the mountain lands of the county should never have been cleared of forest. These can only serve as mountain pastures or for reforestation.

#### NEW YORK.

The survey of Tompkins County, N. Y., was completed in 1906, and also a survey of the Binghamton area. With this work a series of surveys from Lake Ontario southward across the central part of the State has been made. The diversity of climate, altitude, and espe-

cially of soils shown in central New York indicate that not nearly as great a diversity in cropping is being followed as is practicable.

A survey in Niagara County has been begun to determine the characteristics of the soils suited to the production of the various kinds of fruits produced in the county.

A similar survey is being carried on in Madison County to determine the eastward extension of the soils suited to the production of tobacco and alfalfa which have already been mapped in central New York.

#### NORTH CAROLINA.

In North Carolina a survey was made of New Hanover County. In this region the production of truck crops for the northern market is assuming considerable importance. The variety of soils encountered leads to the belief that many truck crops may be grown in succession on them and that a very intensive system may be followed.

A survey of Chowan County was also made. Here the chief crops are cotton, corn, and peanuts, which are used for hog feeding. Some trucking is also being carried on, and the practice may well be extended.

#### NORTH DAKOTA.

In North Dakota the Carrington area was completed in 1906.

A survey of an area around Williston is now in progress. In this region an extension of the irrigation of the valley lands is to be made, and a determination of the crop adaptations of the soils will be of considerable value. Small areas of soils affected by alkali have been encountered, but with irrigation the trouble will probably not be of any extent. A survey of Ransom County is also being made.

#### OHIO.

Surveys of the Cleveland and Westerville areas in Ohio were made in 1906. Both are prosperous general farming regions. These surveys will furnish a basis for additional research work by the Ohio Agricultural Experiment Station.

#### OKLAHOMA.

Soil-survey work was started in Oklahoma by a survey of Oklahoma County.

#### PENNSYLVANIA.

In Pennsylvania the contiguous counties of Montgomery and Chester, in the southeastern part of the State, were surveyed. Both counties are well farmed to general crops, and in addition some very intensive agriculture is practiced near the cities. The more hilly parts of both counties are well fitted by both soil and climate for apple and other fruit culture. Considerable dairy and stock-raising interests exist in both.

#### SOUTH CAROLINA.

Work in this State was continued by the survey of Cherokee and York counties. Cotton is the chief crop in each and the raising of



stock is being revived. A more intensive system of cropping would not only increase the profits of the farmers, but would also, if rightly planned, increase the yields of the staple crops.

## TENNESSEE.

In Tennessee the work in Henderson County was completed and a survey in Madison County was begun. In the latter county an area of bottom land exists which should be reclaimed, by proper drainage, for agricultural uses. The chief crop of the area is cotton, though greater diversification should be introduced. The excessive erosion of some of the upland soils could be prevented by the growing of grass and other forage crops and by proper care in the tillage and contour cultivation of the fields.

## TEXAS.

Lee County was completed and the surveys of the Henderson and San Marcos areas were undertaken in 1906. A great diversity of soils was encountered in both these areas. In the Henderson area the soils of the Orangeburg series were encountered, upon which tobacco culture has been satisfactorily tested in other parts of eastern Texas. Some peaches and other fruits are grown in the area and their culture might well be extended.

In the San Marcos area, while general farming prevails, with cotton the chief crop, the irrigation of tracts along the San Marcos River has given rise to an increasing production of very early truck crops. The upland soils of the area are suited to the production of cotton, corn, alfalfa in some instances, and of other grains and grasses. Stock raising is passing from the range to the inclosed pasture stage and still maintains an important rank in the agriculture of the region.

## VIRGINIA.

The requests for additional surveys in the middle Virginia region were met by surveys of Hanover and Louisa counties. In Louisa County the farms are largely operated by the owners and are tilled to general crops and tobacco. The light fire-cured type is grown, especially upon the more sandy soils.

In Hanover County, in addition to the tobacco industry, there is an opportunity for more extensive production of garden and truck crops.

## WASHINGTON.

In Washington, surveys were made of Island County and of the Everett area. In both areas only a small part of the land that will ultimately be available for agriculture is now farmed. The diversity of soils in both areas will admit of the production of quite a range of general and special crops.

## WEST VIRGINIA.

A soil survey of Upshur County, W. Va., was completed in 1906, and an additional area around Wheeling was begun. The southern part of Upshur County remains largely in timber, but the northern

part is devoted to farming and stock raising. Little fruit is raised in the county, though apples might be produced to advantage on some of the hill slopes.

## WISCONSIN.

The work in Portage County was completed in 1906. In this area there exists a considerable amount of undrained swamp, which when properly drained may be used for the production of farm crops. Upon the uplands oats, hay, and potatoes are the chief crops, and the growing of potatoes is becoming one of the chief industries of the region. These lands were originally in pine and have been cut over and taken up for agricultural uses within recent years. They represent considerable areas in central and northern Wisconsin. The survey of Racine County was begun in 1906.

## REVIEW OF THE WORK.

It will be seen from this brief review of the work of the soil survey that a great diversity of American agricultural interests has been served by the areas mapped in 1906. While areas devoted to almost all of the great staple crops have been investigated, the surveys also show that still other crops should be introduced in addition to those already grown. In the majority of the areas the diversity of soil is much greater than the diversity of crops.

**TRUCK SOILS.**—Along the Atlantic seaboard the great problem is that of properly suiting the chief truck crops to the soils of the region. This has already been accomplished in most of the older communities where such crops are grown, and the information there secured by experienced truck growers is being brought together by the survey for the benefit of the newer trucking areas. A systematic study of these areas is desirable, and such a complete study of the truck soils of the Atlantic and Gulf coast States should be made in the near future. One of the older and more experienced men of the survey force should be assigned to this problem, to visit all of the field parties working in the regions mentioned. He should study the soils used for the growing of the great variety of crops reported, paying special attention to the texture and drainage conditions most favorable to each crop, to the methods of soil management and to the details which give rise to success in this intensive branch of agriculture. When this work had proceeded to the proper stage it would be possible to present the results as a complete guide to the soils best adapted to the various truck crops and as an indication of the proper methods to be pursued in the handling of each soil.

**TOBACCO SOILS.**—In the same way a study should be made of the characteristic soils adapted to the production of the different kinds of tobacco. Possibly no other American crop depends so closely upon the peculiarities of the soil upon which it is grown. Not only is this staple highly specialized in its development into different types suited to different purposes, but each type seems to be best grown upon a soil of marked individual properties. The type of tobacco grown on the heavy clays of the Kentucky and Tennessee region differs totally from the type grown on the sandier lands of middle Virginia and

North Carolina. Both of these are unlike the tobacco which can be produced on the lands of the Coastal Plain of Florida or Texas. In fact, an enumeration of the different types of tobacco raised in the United States at once discloses that each marked soil region has its own peculiar kind of tobacco suited perhaps to totally different uses.

**FRUIT SOILS.**—The fruit soils of the country are being discussed by an increasing number of men who desire to engage in fruit culture as a special branch of agriculture. The day when the majority of the various fruit crops were grown as a side issue in connection with other farm crops is passing. Peaches have been produced as a specialty for many years, and during the last decade the growing of apples has come more and more to assume a similar status. The development of new apple areas has been rapid in the last ten years, and some of the extensive plantings have shown, upon coming into bearing, that special care must be taken in the selection of the proper soils and the correct conditions of drainage and exposure for the location of orchards. The work of the soil survey has in a general way been directed to many of these points. This has been the case in the surveys of the pippin areas of Virginia, of the newer region in the Ozark both in Arkansas and Missouri, in the apple belt along the Lake Ontario shore in New York and elsewhere. It would be highly desirable to assign to a special study of the fruit soils of the country one of the soil-survey men who is an expert along this line of investigation.

**CORN SOILS.**—Work in all parts of the country has impressed on the staff of the Bureau of Soils that the typical corn soil of one region may be much less suited to corn production in other localities not far distant. In fact it is coming to be recognized that each locality possesses soils which under their own peculiarities of climate are well suited to the crop. Thus in the central prairie States the loam and silt loam soils of the Marshall series are preeminently suited to corn. On the other hand, the soils for profitable corn production in New England and New York must be the lighter and warmer gravelly loams and light loams. In other regions other soils are best suited to the crop. A further study of the corn soils of the country which would elaborate and enforce these observations should be made. This typical American crop is coming more and more to be the dominant staple and every effort should be made to maintain American supremacy in its production. The crop has its greatest value as the basis for extensive cattle feeding, even a greater value than for export, and all parts of the country should approximate the production of the amount needed for local uses.

**WHEAT SOILS.**—The public statement has been made by an official of one of the great transportation companies that within the next decade the home consumption of wheat will nearly if not quite equal the amounts now being annually produced. If such should prove to be the case the area devoted to this crop must be increased, and some regions now devoted to other crops must be given over to wheat growing. That many areas where the crop is now only a secondary one might become important wheat-producing communities is certain. In some of the South Central States new varieties of wheat and new methods for producing the old varieties would lead to a considerable



extension of the crop. It is also popularly believed that in some of the established wheat-growing sections the yield of grain has materially decreased in the last ten years. In some of these areas the Bureau is conducting experiments to test the proper fertilizers and manure to be used in restoring these soils to their former productivity. The special study of the wheat soils should be pursued as recommended in the case of corn soils.

**COTTON SOILS.**—The situation with regard to cotton is even more complex. The ravages of the cotton boll weevil continue, and in some sections the acreage of cotton is being materially reduced. In other places new lands are being devoted to cotton culture and other lands are coming to be more intensively farmed with cotton as one of the crops of the rotation. It is undoubtedly true that the acreage devoted to cotton may be considerably reduced without a corresponding decrease in the total production of the crop, if at the same time the methods of cotton growing are so reformed as to give the maximum yields of which the soils are capable. In some instances that have come under the observation of the Bureau field parties the changes of method have resulted in multiplying the yield two or even three times. Upon many soils now growing only one-half to two-thirds of a bale per acre proper tillage, correct fertilization, and well-chosen crop rotation would result in the production of a bale per acre. The endeavor of many cotton-growing communities should be toward the production of more cotton per acre rather than toward the planting of more acres. The study of the soils of the many important cotton regions of decidedly different characteristics should be pushed through additional surveys in the Gulf and South Atlantic States. At least one experienced field man should be assigned permanently to oversee this work.

**COOPERATION WITH THE RECLAMATION SERVICE.**—In the Western States the work of the Reclamation Service is reaching such a stage that soil surveys are being requested for a number of the projects. No regular assignment of men for this class of work has yet been made, although several areas of this kind have been surveyed. At least two field parties should be assigned to this work for the future. The land to be reclaimed is often of very high value for special lines of crop production, such as fruit growing. Some of it is affected by minor accumulations of alkali, which if handled properly from the start need not give serious difficulty. It is of the greatest importance that the survey of these areas be conducted before the lands are largely occupied for agricultural purposes.

#### LABORATORIES.

The laboratories have continued to furnish the physical and chemical data necessary for the interpretation of the field studies of the Bureau. The amount of analytical work thus required has continued to increase in spite of efforts to keep this work within the smallest limits consistent with the requirements of the field investigations. The increase is due mainly to the growing demands for such data from other bureaus and offices which are finding that their investigations require a fuller knowledge of the soil. Besides furnishing such analytical data the laboratories have continued certain

fundamental investigations called for by the problems encountered in the field work and necessary to an understanding of the handling of soils and fertilizers.

The modern methods of analysis of soil solutions have been brought together in a publication. Many of these methods have been devised and perfected in the Bureau. The publication thus makes accessible to all soil investigators information which hitherto was widely scattered and out of the reach of many.

The movement of water in typical soils of agricultural importance and the distribution of moisture at various points between the level of the ground water and the surface have been experimentally investigated. The distribution of water at various depths has been shown to have certain analogies to electrical and thermal phenomena, which are suggestive of new methods of attacking the larger problem of the mutual relation of soil and water. It has been found that the optimum water content of a soil is closely related to other important physical properties in addition to being the water supply for plants, and thus this moisture content is a factor of the utmost importance in the growing of crops. Intimately connected with this subject is that of evaporation of water at and below the surface of the soil under various conditions of mulching and packing. The amount of water lost from below the surface has been found to be practically negligible in comparison to the losses due to direct evaporation from depths within a few inches of the surface. The capillary rise of soil moisture under humid and arid conditions has also been experimentally investigated, and the loss of water under arid conditions was found to be considerably greater than under humid conditions for a short period of time, but subsequently the arid soil was automatically covered by a mulch which protected it from further rapid loss of water. These experiments explain field observations, that soils in arid areas while very dry for the first few inches retain their moisture at lower depths much more persistently and for greater length of time than do soils in humid areas.

Of the properties of soils which influence their crop-producing power the next in importance to the water-holding power is probably their absorptive capacity. All soils show this remarkable power of absorbing many substances from solutions, a power which operates until a definite relation is established between the composition of the solution and the amount absorbed by the soil. Of the inorganic substances which a soil absorbs the most important are the common fertilizer constituents, and consequently a detailed study of the phenomena accompanying absorption is of prime importance in the development of a rational system of fertilization. It has been found that the rate at which the soil absorbs one of these mineral fertilizers from a solution follows a definite and simple law, and the converse process of leaching follows a similar law. The continual leaching of a soil which has absorbed large quantities of mineral fertilizers shows that after a short time the composition of the percolate diminishes so slowly as to be practically constant, no matter how much of the absorbed material may yet remain in the soil and no matter how soluble this absorbed material may be in the absence of the absorbing agent; and it has further been shown that for different soils these concentrations of the several constituents vary over a narrow range and are approximately those of the original soil solution. Solu-

tions having a concentration of soluble salts much in excess of that sufficient to kill plants have been added to soils and allowed to remain in contact with them several days, after which time crops have grown satisfactorily, because the soil by its absorptive power automatically reduced the concentration of the solution below the limit which is inimical to plant growth. In this way plants have been successfully grown in soils to which as much as 3 or 4 per cent of sodium carbonate was added, although the limit of concentration of this salt permitting plant growth is approximately one one-hundredth of 1 per cent. The maximum amount which a soil can absorb seems to bear a definite relation to the crop-producing power of the soil—that is to say, those soils which are recognized in the fields as strongest, or that maintain their fertility the most readily, are those which the laboratory examination has shown to have the highest absorptive capacity toward both mineral and organic substances. The absorptive capacity of a soil has been shown also to have a definite relation to its physical condition, which in turn is undoubtedly dependent to a large extent on the degree of flocculation of the soil grains.

In the irrigation of certain alkali soils their power of absorption of the alkali salts plays an important part. It has sometimes been supposed that the carbonates which form the principal constituents of "black alkali" can not be removed from soils by irrigation and drainage, although this has proved successful in reclaiming soils carrying "white alkali." The laboratory investigations, however, have shown conclusively that "black alkali" can thus be removed from soil even when it contains also considerable quantities of the white alkali salts, but that the amount of water and the time required is much greater than in the case of "white alkali" soils.

A method has been devised which by automatically maintaining the atmosphere in a confined space at a definite humidity brings substances which are either too wet or too dry into any desired state of moisture content. This method has been used for tobacco of various kinds and has proved satisfactory not only in the laboratory, but on a small scale commercially, and gives promise of successful application to factory conditions.

One of the important constituents of the soil in arid regions that determines the character of certain types of alkali is the mineral gypsum. Studies on the solubility of this substance have been continued during the last year. Its solubility in solutions of all the common salts and in mixtures of these salts has been determined, so that it can now be safely said that the chemistry of many types of alkali soils is well understood. The study of the chemistry of the remaining types, including those containing carbonates, is well advanced and will soon be brought to the same stage of completion. These investigations, which are fundamentally important and absolutely necessary for an intelligent handling of the alkali problem, have proved to be of great value in physiological investigations of plant life, in geology, and in many technical processes. The information obtained from these investigations has explained the hitherto inexplicable observation that frequently the drainage water from any given alkali-containing tract shows a constant proportion between all the mineral constituents, although the absolute amount may vary considerably from time to time.

The investigations on the solubility and leaching of the phosphates



found in the soils and those used as commercial fertilizers have been continued with special reference to those which occur in fertilizers. This investigation has been extended to thorough study of superphosphates, and it has been determined what changes take place when this substance is added to the soil and at what relative rates the several constituents will be extracted by the soil water. A study of the other phosphates, such as magnesium, iron, and aluminum, present in comparatively small quantities in superphosphates, will reach completion at an early date.

Investigations have been continued on the mineralogical and chemical composition of the different sized grains in the soil, on the absorptive powers of different soil types for the several mineral and organic fertilizers, on the influence of large amounts of surface, especially soil surfaces, upon the rate and character of the chemical processes, on the characteristics of the soluble organic materials in the soil, and on the relation of soil structure and tilth to the amount and character of the soil solution and to climatic environment.

#### SOIL FERTILITY INVESTIGATIONS.

A marked advance has been made during the last year in developing methods of soil fertility investigations, and the Bureau is now in a position to determine in soils the factors or causes of low crop production. The crop yield is influenced by climatic conditions, by the lack of adaptation of a class of crops to the soil type, by the physical condition of the soil, and by certain inherent conditions of fertility or infertility in the soil itself which in the past have been but little understood. Even when all the climatic and physical conditions are right, there are nevertheless many soils which give continually decreasing yields, until they have so materially deteriorated as to make the advisability of continuing their cultivation a serious problem for the farmer. It is this inherent infertility in soils which good farm practice aims to overcome by the use of fertilizers, stable manures, or green manuring, and it is this inherent infertility as a factor in low crop production, and the action of these fertilizers on the soil, which the Bureau has been studying. The determining of the inherent factors of fertility and infertility leads to a more rational treatment of the soil, both as regards soil management problems and as regards the application of specific fertilizers.

Extended investigations have shown that in many soils the causes of low yields may be directly ascribed to substances which are in themselves inhibitive to plant growth; that is to say, it is not always or even generally the absence of beneficial constituents but the presence of substances deleterious to plants. The causes of low yields are in some soils overcome by the action of mineral fertilizers, by organic manures, by green manures or liming, by the introduction of an efficient system of crop rotation, or even by purely cultural methods. The toxic condition of some soils can also be frequently alleviated by treatment with certain nonplant-food organic substances. There are other cases, however, where none of the treatments at present known will remedy the low yield within reasonable time and economically, and it is probable that new substances will have to be found to counteract the toxic influences in such soils.

The determination of the exact nature of these toxic bodies will

probably prove a very difficult task, as only small quantities seem to be involved, and separation by ordinary means is exceedingly difficult. The question as to the origin of these substances, whether they are formed by the accumulation of root excreta in a soil where these are not taken care of by natural processes of destruction or decay, whether they are the products of bacterial or other life within the soil, or whether they are formed by the decomposition of vegetable matter under unfavorable conditions in the soil, is still a subject for further investigation. These various problems can only be solved by a thorough study of soil physiology, but their solution will be of the greatest value to agricultural science, will enable us to unravel the more intricate problems of the soil, and to understand the rôle of organic and inorganic fertilizers, furnishing in the end a basis for rational agriculture.

It is known in agricultural practice that the beneficial effects of well-rotted stable manure can not generally be attained by the use of equivalents of the mineral plant-food constituents in the form of commercial fertilizers. It has been possible to show that the organic substances in such a manure have in themselves a function in promoting plant growth other than that of nutrition. This function seems to be rather one of providing the best possible conditions for plant growth by the removal of or action upon detrimental substances in the soil or soil extract, or by direct action upon the excreta of plants.

While these investigations into the dominating factors or causes of infertility are being carried on with a view to acquiring knowledge of the ulterior causes and of the origin of these causes, there has been devised for the use of the farmer a method of direct practical application in which the soil is tested by means of growing plants in soils treated with various remedial agents for infertility commonly employed in agricultural practice in the form of various commercial fertilizers, stable and green manures, lime, etc. The results obtained by these determinations of the manurial requirements of soils are directly applicable to the field and to the different kinds of substances at present available for agricultural treatments. Considerable work has been done along this line and results of decidedly practical importance have been obtained, and wherever it has been tested the method has been found to conform with the experience of practical agriculture in the field.

The method has been especially tested with the soils of some of the experiment station farms where records of their soils were available for a period of from ten to twelve years. At the Ohio Experiment Station, at Wooster, and at the Rhode Island station, at Kingston, it has been found that with these small pots in a two weeks' culture of wheat plants essentially the same conclusions have been reached for the different soil treatments as had been obtained by these stations repeatedly in the field during this period, or in some instances only after experiments lasting ten or twelve years. The method has thus been thoroughly checked against the wide recorded experience in plot experiments, as well as against the general field experience of practical farmers. This method, therefore, places in the hands of the farmer and practical soil investigator a ready means of testing his soils to determine the fertilizer or manurial requirements without the great expenditure of time, labor, and money involved in plot or field experiments.

## MANURIAL REQUIREMENTS OF SOILS.

The Bureau of Soils is now in a position to test the manurial requirements of soils with a fair degree of accuracy. During the past year an investigation has been carried on by which 200 soils have been tested. These soils represent about 80 types derived from a number of different geological formations. They were taken from twenty-three States, extending from the Mississippi River to the Atlantic seaboard and from Rhode Island to Texas.

In this investigation the value of nitrogen, potash, and phosphorus in the form of nitrate of soda, sulphate of potash, and acid phosphate, respectively, of lime when air-slaked, of well-rotted barnyard manure and of finely ground cowpea vines was tested. These ingredients were supplied to the soil separately and in various combinations. Wheat of the same variety was used throughout as the test crop and all of the conditions for growth, excepting the manurial treatments to be tested, were maintained as nearly uniform and ideal as possible. With the same ingredients, used in like form and in the same combinations, and with the same crop, the results obtained from the 200 tests are strictly comparable, and far exceed in number any other similar tests that can be brought together on a comparable basis. The paraffin-pot method, described in Circular No. 18 of this Bureau and mentioned in another page, was used in this investigation, and while it is not designed to supersede field tests, it is admirably adapted to an investigation of this character and is very useful as a method for indicating what fertilizers should be tested in the field.

While these tests are not sufficient in number to enable a satisfactory study of so vast an area as that from which the samples were taken, the results so far obtained indicate, with a few exceptions, that the manurial requirements of soils depend far more upon the class of crops grown, the character of fertilizers or manure used, and the treatment given than they do upon the type of soil or geological formation from which it is derived. As a rule the manurial requirements of the soils of a county or district where the agricultural practices are fairly uniform show but little variation, even though the district may embrace numerous soil types. On the other hand, the same soil type occurring in widely separated districts may show a marked difference in manurial requirements, presumably as a result of the differences in practices which prevail in the two districts. As an illustration of this fact I would cite a few instances. Five tests in triplicate of soils from Waycross, Ga., show a marked uniformity in the manurial requirements regardless of the fact that they represent five types and two soil series. The same soils in Escambia County, Fla., show a very different requirement. In the former area nitrate of soda is about three times as efficient as sulphate of potash, and while lime is decidedly beneficial it is not so much so as nitrate of soda. In the latter area sulphate of potash is equally as efficient as nitrate of soda, and lime is more than twice as beneficial as the three fertilizing ingredients combined. A Cecil loam from Louisa County, Va., was markedly benefited by all three of the fertilizing ingredients and lime, while the same soil at Appomattox, Va., was not appreciably improved by any of the ingredients or by lime.

In the States of Wisconsin, Iowa, Missouri, Illinois, Indiana,



Ohio, New York, and Pennsylvania the response to the ordinary forms of commercial fertilizers has been moderate, slight, or in many instances almost imperceptible. In those States organic manures in the form of cowpea vines or stable manure have been very much more effective than the chemical ones. Lime alone has seldom shown a marked effect. While the results obtained for these States are insufficient to be representative, they are in conformity with the general practices of the vast majority of the farmers living there, who as a rule do not purchase commercial fertilizers for use in the growing of general farm crops, but who for the most part recognize the high value of barnyard manure and generally utilize all that is produced upon the farm.

In the Atlantic and Gulf coast States, where a large number of observations have been made, the soils with few exceptions respond in a marked degree to the use of chemical fertilizers and lime; and while cowpea vines and barnyard manure are in the majority of cases superior, the relative difference between the values of these substances is less marked than in the first-mentioned group of States. Here the relative value of the three important ingredients—nitrogen, potash, and phosphorus—as measured by the growth of plants, assumes the same order in eighty out of one hundred instances, the rank being nitrogen first, potash second, and phosphorus third, or lowest.

The muck soils, regardless of locality, respond to potash more than to any other of the ingredients. There is also a tendency for potash to hold a relatively higher rank in the dark-colored soils of the prairie States and in some of the clay and clay-loam soils of the Piedmont section.

#### ALKALI LAND RECLAMATION.

An important branch of the Bureau's work is the investigation of methods for reclaiming alkali soil. As is well known, widespread damage and injury have been caused in many of the western irrigated districts by the rise and spread of alkali, and large areas of fine land have become unproductive on this account. It has long been the policy of the Bureau to study this important question, not only by mapping the extent and distribution of affected land in the various districts, but also by pointing out remedies to check the spread as well as to restore worthless lands to their former productiveness. As described in my former reports, it was deemed advisable actually to demonstrate that by certain methods even the worst lands could be freed from alkali and made to produce good crops.

Five stations were selected at various points in some of the most important irrigation centers where it seemed this work should be carried on. At each of these places were chosen tracts of from 20 to 40 acres of strongly impregnated alkali land. On four of these tracts the removal of the alkali has been a complete success, as demonstrated by the growth of fine crops, and while on the fifth tract some of the alkali has appeared obstinate and difficult to remove, a large part of the land is in excellent shape, having been fully reclaimed. This work of the Bureau has amply proved that land containing even excessive quantities of alkali can be sufficiently reclaimed to permit the growth of crops by repeated flooding for a few months. To

remove successfully such large quantities of alkali it is necessary that the soil be well drained to a depth of several feet. In the majority of cases where excessive accumulations of alkali have occurred the drainage of the soil is so poor that some form of artificial drainage must be supplied before beginning operations. At each of the demonstration stations the Bureau installed a drainage system consisting of lines of drain tile laid at an average depth of 4 feet and at intervals of 130 to 225 feet, the distance between the drains depending on the texture and character of the soil. The average cost of installing these systems was about \$20 per acre, governed largely by the cost of tile delivered at the nearest freight station, the local price of labor, and the character of the soil through which the ditches were excavated. Considering the rapid increase in value of all irrigated land capable of yielding good crops, the cost of installation is not excessive and is compensated soon after the land has become productive again.

The progress of the work on the several demonstration tracts during the fiscal year just closed may be described as follows:

On the Swan tract, situated 4 miles west of Salt Lake City, Utah, the work consisted largely of making experiments with various crops, as the removal of the alkali had practically been accomplished by repeated flooding for several months in 1903 and for a short period in 1904. Thirteen acres planted to alfalfa by the Utah Experiment Station in the spring of 1905 made a fine growth and now compares favorably with crops planted on alkali-free soil in various parts of the State. Many other crops were planted in 1905, some of which required considerable cultivation, and while the early growth was fair the lack of attention was evident later in the season. Ten acres that had been planted to wheat the previous year, although planted late, made good growth and produced a fair crop of heavy wheat of excellent quality.

The Bureau took control of 17 acres of the Swan tract early in July, 1905, the remaining 23 acres continuing under the direction of the Utah Experiment Station. This land was carefully leveled to insure more even irrigation, the soil prepared early in the spring of 1906 and seeded to alfalfa, using oats as a nurse crop. The stand promises to be very good. This makes 30 acres in alfalfa, and while the crops planted on the remaining 10 acres are not perhaps as sensitive to alkali, by their growth they clearly demonstrate the great changes that have taken place in the soil since it has been treated. The fact that alfalfa can be successfully grown shows that the removal of the alkali has been most thorough, since it is well known that young alfalfa is one of the plants most sensitive to alkali. Formerly this field presented a most desolate appearance, with large areas heavily incrustated with alkali and a scattering growth of the resistant greasewood.

The success of this experiment can not but be far reaching in its influence upon the alkali question in the Salt Lake Valley. There are thousands of acres of land now lying idle, and much of it can be reclaimed at a small outlay of time and money. While the present water supply is perhaps too limited to warrant the reclamation of very extensive bodies of land, it is nevertheless adequate to reclaim and irrigate many hundreds if not thousands of acres of apparently worthless soil. The opening of a few deep ditches

to supplement the natural drainage, followed by short periods of flooding, is all that is necessary to sweeten much of this land sufficiently to allow profitable cropping.

On the Toft-Hansen tract,  $3\frac{1}{2}$  miles south of Fresno, in the San Joaquin Valley, California, some important changes were made during the year. Our former work had resulted in freeing the upper layers of soil from alkali and very satisfactory crops had been grown, and while the alkali question had been solved, a constant source of danger was the high ground water which rises very rapidly in this district after water is turned into the canals each spring. The original drainage system was not placed very deep and on account of the slight fall and small size of the tile in all laterals the question of keeping the drains free from sand and silt proved serious. In order further to experiment with lowering the ground water, reclaiming the soil to a greater depth, as well as keeping the drainage system open and efficient at all times, it was thought advisable to install a new drainage system. This was completed in November, 1905, an opportune time to carry on such work, as the ground water was then  $8\frac{1}{2}$  feet below the surface. The entire drainage system was lowered from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet. All lines of tile were given more fall, while no tiles were used smaller than 4 inches in diameter. A galvanized-iron wire cable was also placed in all lines of tile, to which steel-wire brushes can be attached and drawn through the tiles as often as necessary to keep them free from silt and roots.

As soon as the water was turned into the canals the ground water rose rapidly, and it was evident that on account of the increased depth of the drainage system the pump for the drainage water must be able to remove not only the water from the land drained but also the seepage water from adjoining lands. Attempts to increase the efficiency of the old bucket pump proved ineffective, so that a small centrifugal pump was attached to the water wheel operated by the irrigating canal. It was the general opinion that the centrifugal pumps could not be successfully operated by water wheels. This opinion proved erroneous, since from the day the pump was installed it has easily removed the sand and silt carried by the drainage water, which was one of the chief difficulties in maintaining the bucket pump in good repair. The pump now keeps the ground water at a safe depth not only under the land drained, but under adjoining farms, to the extent of 100 acres. On much of this land in former years the ground water frequently stood a few inches from the surface for months at a time. Many engineers, farmers, and other interested parties have watched with the greatest interest our efforts to solve the problem of lowering the ground water, since it is the first essential step in any extensive attempts at removing alkali. The success of this work has proved of great value to the farmers of the alkali and seepage infested district about Fresno, and many have signified their intention of undertaking work similar to that carried on by the Bureau.

In addition to caring for the details of the work on the Toft-Hansen tract, a number of observations and experiments upon the treatment of alkali land are being conducted upon the soils of neighboring farms. At the close of the present irrigating season the



Bureau's work in the Fresno district will close, as the owners of the land are well pleased with the reclaimed condition of the soil and the success of the newly installed drainage system. They believe in the efficiency of this method of reclamation and are making plans to extend the drainage system to other parts of their farms affected by alkali. It is the intention of the Bureau to issue a bulletin fully describing the results of these experiments in alkali reclamation, together with a detailed discussion of the alkali situation in the Fresno district, and to show just what steps are necessary to check the extensive damage inflicted upon the valuable vineyard and fruit lands of this part of the San Joaquin Valley.

In Washington, in the Yakima Valley, the results have not been quite as satisfactory as was hoped when the work was commenced. While parts of the Gervais tract of 20 acres, situated  $3\frac{1}{2}$  miles south of North Yakima, have been thoroughly reclaimed, and produced in 1905 a heavy crop of wheat hay, valued at \$160, other parts of the tract have not yielded to treatment so readily. To determine just how far the reclamation of the soil had progressed, alfalfa and wheat were sown in the fall of 1905. While the early growth of these crops was quite favorable, late spring freezes badly damaged both the wheat and alfalfa, not only on the tract, but in many other parts of the valley. On those parts of the tract where the damage from unfavorable weather conditions was most manifest the soil was prepared and reseeded with the object of eventually securing a stand of alfalfa on the entire tract before freezing weather sets in this fall. That some parts of the tract still contain appreciable quantities of black alkali is evident from the crop returns, from repeated chemical tests, as well as from the characteristic dark stains in the soil. In view of the success obtained in leaching the alkali from the soil in the other tracts it is somewhat difficult to explain its retention by the soils of the Yakima Valley. It is well known that hardpan retards the movement of alkali; it seems probable also that the volcanic ash soils of this valley may have a high absorptive capacity, enabling them still to retain injurious quantities of black alkali in spite of repeated flooding. Laboratory tests are being made to determine just what quantity of black alkali is retained by these soils after long-continued leaching. It may be found that in order to eliminate all the alkali from the soil other methods of treatment may be necessary. It will be necessary to determine this before the Bureau can recommend specific treatment for the affected lands of this flourishing valley. Land values are so high and good lands produce such profitable crops that the exact treatment for the alkali lands should be ascertained if possible, even though such treatment be somewhat expensive and the total cost of reclamation be great as compared with the cost of reclamation in other districts.

The record of the Cummings tract, in the Salt River Valley, Arizona, is excellent. A tract of 20 acres was selected for demonstration work  $3\frac{1}{2}$  miles south of Tempe. The field once produced good crops, but the rise and spread of alkali prevented any profitable crops from being grown on it, as well as on many adjoining farms. A drainage system was installed early in 1904, but no water was available for leaching out the alkali until many months later. When the water supply became more abundant, the removal of the alkali

was comparatively simple. At the present time 14½ acres supports a fine stand of alfalfa, planted in November, 1905, while the remainder produced a heavy crop of barley. Bermuda grass had proved troublesome on parts of the tract in former years, and barley was sown to allow more frequent stirring of the soil to destroy all traces of the Bermuda before seeding to a permanent crop like alfalfa. To insure immunity from Bermuda grass this part of the tract will be carefully cultivated until time for sowing alfalfa this fall. The owner of the land is fully satisfied with the showing of the crop and only awaits the seeding of the small part of the tract to alfalfa before accepting the land according to the contract originally agreed upon. As the water supply of the valley is still further increased by the extensive operations of the United States Reclamation Service in constructing storage reservoirs the subject of eliminating alkali and controlling the ground water will become more important and the Bureau is very fortunate in having undertaken and completed this work at such an opportune time.

The showing of the O'Donnell tract in the Yellowstone Valley, Montana, is fully as good, if not better, than the one just mentioned. This tract is located 1 mile west of the center of Billings, and on account of the alkali could not produce crops, although one or two ineffectual attempts had been made a score of years ago. A drainage system was installed during 1904, but too late to allow any flooding. During 1905 the land was continuously flooded for several months. Heavy spring rains greatly assisted the reclamation. From the outset the drainage system worked perfectly, and large quantities of alkali were removed by the drainage water. Tests made in June, 1906, showed the alkali content to a depth of 4 feet had decreased to approximately 0.20 per cent over the entire tract. In 1904 the soil contained more than 1 per cent to a depth of 4 feet, largely concentrated in the first and second feet. The comparison shows the extent to which the alkali had been removed by a single year's flooding. Early this year the soil was put in order and seeded to oats. This crop by the end of June was nearly a foot high over the entire tract, and gave promise of an excellent crop, which will be harvested in August.

Since alkali can be so readily removed from the soils in the Billings district the outlook is most promising. While alkali was not especially prominent when the valley was first irrigated, after irrigation was commenced it spread rapidly and threatened to become a serious hindrance to successful farming. The spread of alkali was very rapid for a number of years, but more recently there seems to be a tendency for the alkali areas to remain within definite limits, although the concentration appears to be increasing within those limits. Last year sentiment looking to the formation of drainage districts was thoroughly aroused, and during the present year the work of construction is actually under way. One of the worst alkali and seepage areas has been included in a drainage district, and a deep outlet ditch now constructed will serve to carry the surplus water from smaller more detailed drainage systems in individual fields. Smaller local drainage districts are also being formed by private enterprise. After these have been constructed detailed drainage, followed by flooding and cultivation where the

soils contain large quantities of alkali, should affect a cure for the worst alkali soils in the valley. This district is certainly to be congratulated in taking up promptly measures that will eventually solve the alkali question for the entire valley.

In carrying on the work in reclaiming alkali soils the Bureau has had many different conditions to meet and local difficulties to overcome. At each tract the character of the soil differed from that of the other tracts, and at no two places was the alkali condition the same. While perhaps in a few instances some minor mistakes have occurred, the Bureau feels that great progress has been made, and that it is now in possession of much valuable information that will greatly aid the farmer who wishes to undertake the reclamation of his alkali land. That the alkali question is a serious one, demanding immediate attention, no one familiar with conditions in irrigated districts will deny, but the Bureau believes as a result of its experience in such work that the problem can be definitely solved in each district. In the vast majority of cases we feel assured that the farmer who owns alkali land, and who does not undertake the reclamation of a few acres at least every year, is committing a serious mistake. Few farmers even in the worst alkali districts are so poor that they can not, by their own efforts, at least, begin returning their worthless land to its former condition. Even a few acres reclaimed and once more producing good crops would serve as a strong incentive to increase continually the acreage of reclaimed soil.

#### TOBACCO INVESTIGATIONS.

During the fiscal year just closed investigations for the improvement of tobacco have been continued in Texas, Alabama, Ohio, Virginia, and Connecticut. The tobacco grown in Texas during the preceding year was distributed to the trade for the purpose of ascertaining its commercial value. In all 300 samples were sent out, and from the replies received it can be positively stated that the tobacco produced in Texas meets the requirements of the trade as a high-class domestic filler. About 200 acres are now being grown on the Orangeburg soils in Nacogdoches, Anderson, Houston, and Montgomery counties in east Texas, while in central Texas, in Lavaca and Lee counties, experiments are being conducted on similar soils. The industry is now assuming a commercial status, as a ready market has been created for the leaf. The average yield is 600 pounds per acre. It costs the farmer about 9 cents a pound to grow and cure the tobacco, and there is a ready sale for the leaf at 15 cents a pound, leaving a net profit of \$36 per acre.

The Bureau has not conducted any field experiments this year in Texas, its force of experts devoting their time to the supervision of the crops grown by the farmers. Every grower is visited once a week, or oftener if necessary. He is instructed in all the details essential for the production of the crop, from selecting the soil and growing plants to the air curing of the crop, when the tobacco is ready for the packer. Great interest has been shown by the trade, by railroads, and by local interests in the possibilities of east Texas as a tobacco-producing region, and with the promising beginning made



in the counties mentioned there is every reason to believe that this section of the State will soon be recognized as an important factor in our tobacco industry.

The investigations for the production of filler leaf in Alabama have this last year been extended into Dallas County, in the southern part of which the Orangeburg soils appear. In Perry County the acreage increased over 100 per cent. A ready market has been found for the product, and this has proved a stimulus to the growers. The tobacco produced is similar in quality to the Texas and Florida leaf, and the cost of production is a little less than in Texas, owing to cheaper labor. The largest yield obtained last year was 850 pounds per acre, at a cost of 6 cents a pound, or \$51 per acre. This crop sold for 15 cents a pound, realizing the grower a net profit of \$76.50 per acre.

In Ohio the work of introducing the bulk method of fermentation has been continued, and over 25,000,000 pounds of tobacco has been fermented according to the method prescribed by the Bureau. It has taken a period of five years to accomplish these results, and the system is now so well established in Ohio that the packers should be able to proceed without further supervision by our experts.

The work of introducing Cuban seed filler in Ohio has been continued, 25 acres having been planted by the farmers under the direction of the Bureau. This was contracted for with local packers at prices ranging from 18 to 20 cents a pound.

Cooperative experiments have also been conducted with the Bureau of Plant Industry in the selecting and breeding of improved types of tobacco, with a view to securing types of leaf giving a larger yield and having a more uniform quality. Selections were made of Zimmer Spanish, Little Dutch, Ohio Seedleaf, and Ohio Cuban. The seed bolls of these plants were carefully protected by bags to prevent cross-fertilization, a record being kept of each individual plant. It is believed that this method of selecting seed will improve the native varieties of Ohio tobacco, since where so many varieties are grown as in the Miami Valley of Ohio there is great danger of its becoming mixed and deteriorating.

The experiments begun in Virginia in 1904 with heavy fire-cured tobaccos have been continued during the last fiscal year. In the first year of this work it was demonstrated that by the use of carefully selected fertilizers the profits in growing this type of leaf could be increased considerably as compared with those obtained by the average Virginia farmer. During the last year the same treatment of the same land was followed, and between the two crops of tobacco rye was sown as a cover crop and plowed under in the spring. The results obtained show accumulative effects of the fertilizer and cultural methods used.

A 3-acre tract of land was divided into acre plats, each plat receiving a different fertilizer treatment. On plat No. 1 was applied a fertilizer in common use among the farmers, this containing 3 per cent ammonia, 9 per cent phosphoric acid, and 3 per cent of potash. It was applied at the rate of 400 pounds to the acre, at a cost of \$5 an acre, and yielded 12 pounds of ammonia, 36 pounds of phosphoric acid, and 12 pounds of potash to the acre.

Plat No. 2 was treated with a fertilizer prepared according to a formula devised by the Bureau. It consisted of 500 pounds of ground

fish, 10 per cent ammonia, 100 pounds of bone meal, 22 per cent phosphoric acid, 100 pounds of nitrate of soda, 19 per cent ammonia, and 150 pounds of potash—50 per cent potash. This fertilizer cost \$16.46 per acre and supplied 73½ pounds of ammonia, 57 pounds of phosphoric acid, and 72 pounds of potash.

Plat No. 3 was fertilized with 1,200 pounds of ground fish, 10 per cent ammonia; 100 pounds of bone meal, 22 per cent phosphoric acid; 150 pounds of nitrate of soda, 19 per cent ammonia; and 250 pounds of sulphate of potash—50 per cent potash. The cost of this fertilizer was \$32.26 per acre, and it supplied 152 pounds of ammonia, 70 pounds of sulphuric acid, and 120 pounds of potash. The product from these experimental plats was sold at public auction in the Lynchburg market. A statement of the receipts follows:

Plat No. 1. Pocahontas fertilizer:

360 pounds of lugs, at \$5.10 per 100 pounds	\$18.36
367 pounds long leaf, at \$8.25 per 100 pounds	30.27
115 pounds wrappers, at \$10 per 100 pounds	11.50

Total, 842 pounds	60.13
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Plat No. 2. Fertilizer mixture costing \$16:

345 pounds of lugs, at \$5.40 per 100 pounds	18.63
398 pounds short leaf, at \$7.50 per 100 pounds	29.85
493 pounds long leaf, at \$8.75 per 100 pounds	43.13
60 pounds wrappers, at \$15 per 100 pounds	9.00

Total, 1,296 pounds	100.61
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Plat No. 3. Fertilizer mixture costing \$32:

327 pounds lugs, at \$5.40 per 100 pounds	17.65
420 pounds short leaf, at \$7.25 per 100 pounds	32.55
695 pounds long leaf, at \$9.25 per 100 pounds	64.28
85 pounds wrappers, at \$14.25 per 100 pounds	11.11

Total, 1,527 pounds	125.59
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The cost of production for the three plats was, respectively, \$44.50, \$63.60, and \$85.49, which shows a net profit of \$15.63 on plat No. 1, \$37.01 on plat No. 2, and \$40.10 on plat No. 3. It is interesting in connection with this experiment to note that the same plats of ground receiving the same treatment in 1904 netted profits of \$5, \$21, and \$24, respectively. These figures show gains in 1905 over 1904 of \$10.62, \$16.01, and \$16.10, respectively, a result that is highly significant as showing that the productiveness of the soil is being permanently built up and that the enriching effects of the fertilizers and the improvement of the soil through better cultivation are cumulative.

Investigations for the improvement of the bright tobacco of Virginia were also begun during the last fiscal year, ended June 30, 1906, the experimental field being situated near Chatham, in Pittsylvania County, the center of the bright tobacco belt of Virginia and within 20 miles of Danville, the largest market for this class of tobacco. Three acres of land, with the necessary curing barns, have been secured, and the land is divided off into six half-acre plats, on which various fertilizer treatments are applied. On plat No. 1, 500 pounds of a local 2-8-2 fertilizer is used as a check plat. On plats Nos. 2, 3, and 4 the following formula is used at the rate

of 500 pounds, 1,000 pounds, and 2,000 pounds, respectively: 350 pounds of nitrate of soda, 600 pounds of cotton-seed meal, 700 pounds of high-grade acid phosphate, and 350 pounds of sulphate of potash, the percentage being 4.8 nitrogen, 6.2 phosphoric acid, 9 potash. On plat No. 5 only quickly available ingredients were used: 250 pounds of nitrate of soda, 400 pounds of high-grade acid phosphate, 150 pounds sulphate of potash. Plat No. 6 is fertilized the same as plat No. 3, with the addition of 1,000 pounds of lime. The experiment is still in progress and it will be impossible to report any definite results until next year, although the present indications are that plats Nos. 4 and 6 will give the best results, judging by the appearance of the growing crop.

The investigations in Virginia during the last year have been conducted in cooperation with the Virginia Experiment Station at Blacksburg, it is believed to the mutual benefit of the station and the Bureau.

In the Connecticut Valley the work of producing, under shade, a wrapper leaf having the qualities demanded by the trade has been continued, in connection with the breeding experiments of the Bureau of Plant Industry. Eleven selections were taken in a 4-acre tent, seven from Sumatra seed and four from Cuban seed of the third generation in Connecticut. The yield of Sumatra ranged from 1,445 pounds to 1,612 pounds per acre, and of Cuban from 1,134 to 1,384 pounds per acre. Out of these eleven types there have been selected two types of Sumatra and one of Cuban seed that appear to meet the demands of the trade.

Besides the area in the experimental tent of the Department, there were grown last year about 120 acres under cloth shade, both Cuban seed and Connecticut Broadleaf being planted. One firm growing the Broadleaf sold the tobacco for \$1,061.02 an acre, giving a profit of about \$300 per acre. The Cuban tobacco was sold for \$1,200 per acre.

Owing to the serious damage caused annually in Connecticut by pole sweat or houseburn, the Bureau conducted some preliminary investigations in curing sheds containing both the cut and primed tobacco. A detailed record of the moisture and temperature conditions in each shed was kept, as also of the condition of the tobacco, with a view of determining the point of relative humidity and temperature of atmosphere at which tobacco would begin to be affected with pole sweat, and the means to prevent the atmosphere of the shed becoming such as to favor its spread. This study will be closely followed, as it is believed that results can be obtained which will be of great value to the Connecticut growers.

Urgent demands have been made upon the Bureau to extend its operations into Florida, Maryland, Wisconsin, and Tennessee, but owing to the limited appropriation for this work it has so far been impossible to comply with these requests.





## REPORT OF THE ENTOMOLOGIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF ENTOMOLOGY,  
*Washington, D. C., August 23, 1906.*

SIR: I submit herewith an executive report covering the work of the Bureau of Entomology for the fiscal year ending June 30, 1906, dividing it, in accordance with your instructions, into the following headings:

(1) A review of the operations carried on during the fiscal year 1906.

(2) An outline of the plans proposed for the work of the Bureau for the fiscal year 1907 under appropriations already made for that year.

(3) Suggestions as to work recommended for the fiscal year ending June 30, 1908, for use in preparing estimates.

Respectfully,

L. O. HOWARD,  
*Entomologist and Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The work of the Bureau during the year beginning July 1, 1905, and ending June 30, 1906, may be classified as follows:

- (1) Work on the Mexican cotton boll weevil.
- (2) Work on the cotton bollworm.
- (3) Work on other cotton insects.
- (4) Importations of useful insects.
- (5) Investigations of insects damaging forests.
- (6) Investigations of insects damaging deciduous fruit trees.
- (7) Field-crop insect investigations.
- (8) Work on insects injurious to vegetable crops.
- (9) Investigations of insects in their direct relation to the health of man and domestic animals.
- (10) Work on scale insects.
- (11) Work on insects injurious to stored products.
- (12) Experimental work with insecticides.
- (13) Work in bee culture.
- (14) Work in silk culture.
- (15) Miscellaneous investigations and other work.

## WORK ON THE MEXICAN COTTON BOLL WEEVIL.

The boll weevil investigations have been under the immediate charge of Mr. W. D. Hunter.

## GENERAL STATUS OF THE PEST.

The growing season of 1904 was remarkable on account of the comparative scarcity of the boll weevil. At many points the reduction was so great as to give rise to the belief that it had been exterminated or had emigrated to other regions. The causes of this comparative scarcity are complicated. The climatic conditions in the summer and fall of 1904, together with the work of the cotton caterpillar, greatly reduced the number of hibernating insects in the winter of 1904-5; then occurred a long, cold, and wet winter, the most unfavorable winter to the weevil since the insect has been in Texas. Owing to these conditions, some of the area that became infested late in the season of 1904 was entirely void of weevils in the early part of 1905, but the fall movements of the weevil in 1905 more than covered this area. Opportunities were therefore given in the fiscal year 1906 for studies for which there had been previously but little opportunity, and many points that have a bearing upon the possibility of the continued advance of the pest were investigated.

## EXPERIMENTAL FARMS.

The value of experimental field work in its final analysis depends very largely upon the number of seasons through which it has been carried and upon the variability of these seasons. In the case of the boll weevil the insect is constantly advancing into new regions, and is constantly confronting new conditions to which it must adapt itself. For these reasons, during the fiscal year 1906 the Bureau continued experimental field work at fourteen places in Texas and two in Louisiana. The aggregate acreage which was placed under contract in these experiments was 877. On these places, which in most cases have been under observation for several years, the modifications in the cultural system of mitigating damage, made necessary by the changing habits of the insect, were carefully studied. This work, of course, is intimately connected with the work carried on in the laboratory. The experimental fields were located in Anderson, Bexar, Dallas, Karnes, Kaufman, Limestone, Navarro, Robertson, Travis, Victoria, Wharton, and Williamson counties, Tex., and De Soto and Vernon parishes, La. The same form of contract was used as in previous years, and the total cost to the Bureau of the complete charge of the cotton grown was less than \$2,500.

## OTHER FIELD WORK.

In addition to these large-scale experimental plats, numerous experiments were conducted having a bearing on the practical control of the weevil. In one locality an area was found exactly suitable for an extended experiment in the hand picking of the infested bolls. Similar experiments had been tried before, but never under such favorable circumstances. Further tests in the field were made



with Paris green and other poisons in order to check the results of former work. This was deemed necessary on account of the very great importance that has been placed by different people on the possibility of poisoning the boll weevil. An extensive canvass of the State was made to find farmers who had followed the practice of fall destruction of the plants and other recommendations of the Bureau, and their experiments have been collected and tabulated. An especial study has been given the question of the occurrence of volunteer cotton, on account of the important effect which its presence has upon the damage done by the weevil. At the same time many observations have been made to determine the effect of direct sunshine for destroying the pest. Moreover, the continued spread of the weevil has been watched carefully, and publications regarding the new territory infested have been issued in cooperation with the Weather Bureau when deemed desirable.

The Bureau has also withheld a fund to be used if the eradication of isolated colonies should become advisable. There is still danger that outbreaks of this kind will be found far beyond the principal infested region. Whenever a discovery of this kind shall be made the Bureau is ready to attempt the destruction of the local colony. It is possible that in this way the advance of the insect can be considerably retarded.

A careful study has been made of the conditions in western Texas, in order to determine whether the weevil will be likely to spread to that part of the State in spite of the prevalent supposition that such spread will not take place.

#### LABORATORY WORK.

In the main laboratory at Dallas, Tex., much work was done in continuation of experiments already started, but at the same time a number of new lines of work were instituted. In the breeding cages experiments were carried on to determine the effect of different temperatures and condition of food supply upon the development of the weevil. The breeding of parasites was continued, and an especial study was made of a native ant (*Solenopsis geminata*), which seems to be becoming more and more an important factor in the natural control of the weevil. This ant has long been known as the important enemy of the leaf worm of cotton, and is generally distributed throughout the cotton-growing area. It feeds upon nectar as well as upon animal food. Examinations of several thousand squares collected from different localities in Texas showed that this ant destroyed at times as much as 50 per cent of the weevils. The proportion destroyed varied according to the conditions which are favorable for the work of the ant. The adult weevil is not attacked, but the immature stages, and especially full-grown larvæ and pupæ, are most abundantly destroyed. Frequently the ants enter squares which are still hanging upon the plants, but as a general rule entrance is made only after the square has fallen to the ground. Certain points concerning the distribution of this ant, its adaptability to different soil conditions, and the possibility of its artificial propagation, have been studied. In many localities it is certainly the most important natural factor in the control of the weevil, and seems to be becoming more effective.

In connection with the laboratory work, especial studies were made in areas of great weevil abundance and scarcity, in order to determine if possible the reasons for these conditions.

An especial laboratory study was made of the growth in the cotton square or boll known as proliferation, which more or less frequently destroys the weevil. The results of this study show exactly in what ways proliferation affects the insect, and it is hoped that it will furnish a basis for work that may be done by the plant breeders of the Bureau of Plant Industry. Many new features were discovered, and the subject is treated in a bulletin about to be issued.

#### TRUE PARASITES OF THE BOLL WEEVIL.

For many years after the weevil came into Texas it was found that parasites had but little effect upon it. It has recently been ascertained, however, by agents connected with this investigation that in the Brownsville neighborhood at least 50 per cent of the early stages are sometimes destroyed by parasites. In order to ascertain whether it is possible to assist the work of these beneficial insects, an extensive series of experiments and observations has been undertaken in the laboratory. This work divides itself into two branches: (1) An investigation of the possibility of introducing from the North parasites of insects related to the boll weevil, and (2) an investigation of parasites of southern insects related to the boll weevil. A suitable case for transporting parasites has been devised, and much information has been obtained that may have a practical bearing. An instance of this is that the squares which remain hanging upon the plants have been found invariably to show the highest percentage of parasitism. In this discovery is a valuable suggestion for the experts who are engaged in obtaining suitable varieties of cotton for planting in weevil-infested regions. A number of instances of the effective work of parasites on cotton insects other than the boll weevil are well known. In one case the destruction of over 95 per cent of the eggs of the cotton leaf worm by an egg parasite has been noticed. The cotton-square borer (*Uranotes melanus*) is parasitized to such an extent that only one or two, instead of several broods, as would be normal, are allowed to mature in a season. With such analogies and the known success which has attended similar experiments, it is considered that the work relating to parasites of the boll weevil is of the utmost importance. That small results have been gained from the work of parasites up to this time is largely due to the recent invasion of the cotton fields of the South by the insect.

#### HIbernATION EXPERIMENTS.

The most important hibernation work which has been undertaken is referred to in a succeeding paragraph, under the head of "Cooperation with the Louisiana crop pest commission." In addition to that work, however, during the fiscal year 1906 much has been done in Texas and especial attention has been given to determining the maximum time which the weevils can live without cotton. Aside from the 25,000 weevils utilized in the work at Keatchie, La., 15,000 have been utilized in the work in Texas, 11,000 of which were placed in cages at Dallas, where different conditions for hibernation were

arranged. At Victoria another large number of weevils were tested in a similar way, and at Calvert (an intermediate point) still others were used. In addition to the field conditions under which some of these weevils were placed, others were placed in different substances, such as cotton seed, in order to determine the likelihood of their being conveyed in various materials into which they might make their way during their late summer and fall dispersion. This work relative to hibernation will lead to a detailed report on the subject to be issued during the fiscal year 1907.

#### COOPERATION WITH THE LOUISIANA CROP PEST COMMISSION.

The cooperation between the Bureau of Entomology and the Louisiana crop pest commission, which was begun in 1904, when Prof. H. A. Morgan was secretary of the commission, was continued along similar lines during the fiscal year 1906, with Mr. Wilmon Newell, who became secretary in February, 1905. Provision was made for the payment of three entomologists who reported jointly to the secretary of the crop pest commission and to Mr. Hunter, the agent in charge of the boll weevil investigation of the Bureau. During the season of 1905 it was planned to enter upon an extensive study of the so-called migratory movement of the boll weevil on account of the possibility of learning some method of checking further advances or at least of learning the approximate time when other regions may become infested. Unfortunately, on account of the occurrence of yellow fever in Louisiana in the summer of 1905 and the consequent rigid quarantine, it was impossible to carry on this work as planned. Nevertheless, when the quarantine was lifted in November a number of important observations were made.

In cooperation with the Louisiana commission, it was possible for the Bureau to undertake a most extensive series of experiments relating to the hibernation of the weevil. For some years we have been accumulating data regarding the hibernation of the weevil, but the great importance of complete knowledge made it necessary that still more extended work should be begun. In the fall of 1905 more than 25,000 weevils were placed in large cages constructed by the Louisiana commission at Keatchie; 17,600 were collected in Texas and the remainder in Louisiana. In different cages attempts were made to reproduce the various conditions that may be found in cotton fields in the South. Some cages were left with the cotton standing, and in others everything was removed; in others trash, such as moss and logs, as well as cotton seed, was placed. The 18 large cages together gave an opportunity of reproducing a very great variety of conditions. The records of daily emergence of weevils in these cages has been carefully kept. The information obtained will result in the completion of our knowledge as to how the weevils pass the winter, which has hitherto been incomplete.

#### WORK ON THE COTTON BOLLWORM.

The work on this insect during the fiscal year was largely in the character of demonstrations indicating the value of conclusions already reached and detailed in the last annual report of the Bureau. Unlike the boll weevil, the bollworm has existed for such a long



period in this country that no apparent process of adaptation or change of habits is going on. In consequence it has been considered unnecessary to continue the technical work on the life history of the pest. The demonstration work was carried on upon 120 acres of cotton in Hunt and Kaufman counties in Texas, and in the Chickasaw Nation in the Indian Territory. In addition to this work, which was done under contract, some successful efforts were made in the local extermination of the bollworm by means of poisons.

#### WORK ON OTHER COTTON INSECTS.

While incidentally more or less work on other insects injurious to cotton has been done by the force employed in the cotton boll weevil investigations, the bulk of the work in this direction has been done under cooperation with the Texas State Agricultural Experiment Station, at College Station, Tex. An agent of the Bureau has been stationed at the college to devote his attention to some studies of the minor insects of the cotton belt. A very important discovery has been made in connection with these studies, in propagating the predaceous enemies of a plant louse (*Aphis gossypii*), which sometimes causes great damage to young cotton. These predaceous enemies are ladybirds of the family Coccinellidæ, and it has been shown that where they can be started in their work a few weeks earlier than they normally appear the injury by the plant louse will be greatly reduced. Following this suggestion, a very large number of specimens of the various species of ladybirds were carried through the winter, and in at least one instance their introduction into a seriously damaged field resulted in a very short time in the practically complete eradication of the plant louse. It is believed that this work will lead to a practicable method of controlling a pest which causes very considerable damage to cotton.

#### IMPORTATIONS OF USEFUL INSECTS.

The especial lines of work and new introductions which were detailed in the last report of the Bureau have been actively continued. By far the greatest importations of the year have been of parasites and predaceous enemies of the gipsy and brown-tail moths, in cooperation with the officials of the State of Massachusetts, as described below. Some new introductions have been planned relating to fruit insects, and notably the codling moth, and an effort will be made to introduce parasites of the latter insect from France and other European countries the present summer and autumn. The experiments with the kelep or boll weevil ant from Guatemala and the various enemies of scale insects have been under way during the year.

It is possible in many instances to secure the sending of beneficial insects by the official entomologists of other countries without expense to the Department, as was done notably in the case of the introduction of *Scutellista cyanea*, the important enemy of the black scale, from the government of Cape Colony, South Africa. In return for such services and as an earnest for possible future courtesies of the same sort exportations of parasitic and predatory insects have been made from this country, under the auspices of the Bureau, to foreign countries. A notable instance has taken place during the fiscal year.

*Diaspis pentagona*, a scale insect which occurs more or less abundantly upon various fruit trees in portions of the United States, is a serious enemy to the mulberry tree in Italy, and therefore sendings in large quantity of parasitized scales of this species have been shipped to Dr. Antonio Berlese, the head of the Royal Station for Agricultural Entomology at Florence, Italy. After arrival two species of parasites were bred, namely, *Prospalta murtfeldtii* How. and *P. berlesei* How. Attempts have been made to colonize these parasites in Lombardy in the hope that they will prove effective aids in the reduction of the mulberry scale.

INTRODUCTION OF THE NATURAL ENEMIES OF THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

In the last report an account was given of the work undertaken in cooperation with the State of Massachusetts in the introduction of the European parasites of these two extremely injurious insects, whose threatened spread beyond the borders of the New England States is at present a matter of lively concern to the fruit and forest interests of the United States. It was shown that by the cooperation of the official entomologists in European countries and by agents engaged by the Chief of the Bureau during a European trip in June and July, 1905, many hundreds of parasitized larvæ and pupæ of the gipsy moth from various parts of Europe were sent to Boston and held for the propagation of parasites.

Prior to the beginning of this undertaking it was supposed that the entire work would be done in this way, and that the simple sending from Europe to Boston of parasitized full-grown larvæ and pupæ of both of the injurious insects and the subsequent propagation and distribution of the parasites in and from a well-equipped laboratory would be the speediest and easiest method of accomplishing the desired results, but as the investigation proceeded it was found, in spite of a total silence on this point in European records, that the newly hatched larvæ of the brown-tail moth, passing the winter as they do in great numbers surrounded in mass by silken webs and spun-in leaves, are also parasitized. It was further found, also, that the eggs of both the gipsy moth and the brown-tail moth contain parasites in parts of Europe. Therefore arrangements were at once made to enlarge the scope of the sendings and to secure the importation from Europe of large numbers of the over-wintering nests of the brown-tail moth during the autumn of 1905 and the winter of 1905-6 and of the egg masses of both species at a later date. In the meantime a house well situated for laboratory purposes was rented by the superintendent for suppressing the gipsy and brown-tail moths for the State of Massachusetts, Mr. A. H. Kirkland, in the town of North Saugus, in a locality well surrounded by forest growth abundantly infested by both species; and a trained assistant was put in charge. About 150 breeding cages were constructed, and arrangements were made for the erection of large screened structures over infested trees in the woods.

During the winter 117,257 nests of the brown-tail moth were received from 33 localities in Europe, ranging from North Germany south to Hungary and west to Brittany, and comprizing a large range of varying elevations and climatic conditions. Only a small number

of parasites were reared from the majority of these localities, but very satisfactory numbers, amounting to 70,000, were reared altogether, the largest numbers coming from 12 different localities. Of the 70,000 parasites reared, it is safe to say that about 8 per cent were hyperparasites—that is, parasites upon parasites. By the time the parasites began issuing from these nests an expert of the Bureau, Mr. E. S. G. Titus, had been placed in charge, and by means of the specially constructed breeding cages it was a comparatively easy matter for this expert to separate the hyperparasites from the true primary parasites and to destroy the former. There were three species in particular which promised good results, namely, one which for the present must be called *Pteromalus processioneæ* Ratz. and another undetermined species of the same genus, together with *Habrobracon brevicornis* Wesm. They began to appear about April 25 and continued to issue until about June 15. With the cooperation of Mr. Kirkland, a number of localities were found in which there was slight danger of forest fire and in which no work against the moths would be undertaken for at least some months to come, and colonies of various sizes—the three principal ones including, respectively, 10,000, 15,000, and 25,000 parasites—were liberated in the open. At the same time much smaller colonies were placed in the large breeding tents mentioned above. Both the outdoor cage experiments and the open experiments were seriously hampered from the fact that the season proved to be one of extraordinary humidity, from which fact a fungous disease appeared and destroyed a large proportion of the brown-tail moth larvæ in the vicinity of Boston. Nevertheless all three species were seen to lay their eggs in American-born caterpillars, and there is positive proof of the development of at least one generation on American soil of the first-named parasite.

Although these parasites were reared from the extremely small overwintering larvæ of the brown-tail moth, they did not hesitate, on issuing in the spring and early summer, to lay their eggs upon the larger American-born larvæ. Later in the season they were seen laying their eggs in full-grown larvæ of the brown-tail moth and in the pupæ of the gipsy moth.

Analyzing the quantitative rearing of the parasites, it was found that a definite percentage (larger in some localities and smaller in others) of the overwintering larvæ of the brown-tail moth are destroyed by parasites which affect the later stages of growth as well as other related lepidopterous larvæ. The parasites thus have an extremely early start in the season in very large numbers, rendering the subsequent destruction of the injurious caterpillars much more certain than had the parasites passed the winter in an inactive condition.

During the winter, also, efforts were made to import, in the wintering conditions, the two large European ground beetles, *Calosoma sycophanta* and *Calosoma inquisitor*, well known as important European enemies of both of the injurious caterpillars. No success in importing living specimens was gained until March, 1906. From that time on until July 20 small consignments of living adult beetles were received, together with many specimens which died upon the journey. In all 690 living specimens of *C. sycophanta* and 172 of *C. inquisitor* arrived at Boston alive, some of them dying soon after arrival. Colonies were started in various localities about Boston,



including the towns of Winchester, Burlington, Malden, Lynnfield, and Saugus, and in these were placed 360 of the former species and 110 of the latter. Others were kept in cages, and were noticed to feed very heartily, traveling all over the cage and tree searching for and capturing larvæ and other soft-bodied insects. In the open localities the beetles were occasionally seen. Young larvæ were first seen June 17, and early in July nearly full-grown larvæ of the Calosomas were found feeding upon both brown-tail and gipsy moth caterpillars.

In the summer of 1906, beginning with June 7 and continuing until late in the season, larvæ and pupæ of both the gipsy moth and the brown-tail moth were received in considerable numbers from many European localities, the general regions being about the same included in the winter nests of the brown-tail moth sendings. From these a large number of parasites of several different species have been reared, the most abundant having been tachina flies, the percentage of parasitism in some instances having been very great. In lots received from Hungary and from Holland the percentage of parasitism was 100, every gipsy moth caterpillar having been destroyed by its parasite. From the brown-tail moth shipments 1,404 tachina flies have issued, and have been colonized, and 653 puparia are still on hand that will probably over-winter. From the gipsy moth shipments 1,363 parasitic flies of twelve species have been bred, and there are still on hand 3,371 puparia from which the flies may issue next spring. Eighteen out-of-doors colonies were planted, covering practically all of the generally infested regions in the State of Massachusetts, and there is evidence already that a generation of two species has been reared on American soil under perfectly natural conditions, and three additional species have been reared through one generation in the out-of-doors cages—two of them from both gipsy moth and brown-tail moth pupæ and one from gipsy moth pupæ alone. One of the European species has shown a readiness to live upon the native fall webworm and may go through another generation the present summer.

From egg masses of the brown-tail moth received from Europe in midsummer two species of European parasites have been reared and have been noticed laying their eggs in American eggs of this insect.

Thus the outlook for the success of these large-scale importations is good. The greatest care has been taken to prevent the introduction of hyperparasites and other injurious insects, and there seems reason to suppose that sooner or later the complete natural environment of both of the injurious species will be established. This will mean, if it eventually comes about, that the American conditions in relation to both gipsy moth and brown-tail moth will be placed on a par with European conditions and that these insects will cease to occupy their present position as pests of prime importance.

#### NEW COCCINELLIDS FROM EUROPE.

During the late winter months and the spring of 1906 several species of European ladybirds of the family Coccinellidæ, well known as destroyers of plant lice, scale insects, and small soft-bodied insects of other groups, have been imported from Germany, France,

and Austria. Four of these species were received in sufficient numbers to warrant some hope of their establishment in this country. These are *Adalia bipunctata*, *Halysia 14-punctata*, *Exochomus quadripustulatus*, and *Coccinella septempunctata*. All of these insects were liberated in the open in the vicinity of the parasite laboratory at North Saugus, Mass. The country about contains orchards and forests, together with an occasional vegetable garden, and it is hoped that the species will increase sufficiently so that it will be possible to capture at any time specimens for distribution to other parts of the country where destructive outbreaks of plant lice or other insects upon which they will prey may occur.

#### THE KELEP OR GUATEMALAN ANT ENEMY OF THE COTTON BOLL WEEVIL.

In the report of last year was recorded the failure to over-winter successfully in Texas the first colonies of the kelep imported, the explanation suggested by Mr. O. F. Cook, who has this work in charge, being that the colonies were undersized and that their location in Texas was in many cases unfortunate, being in improper soils without adequate drainage. To give further and more satisfactory test, 150 full-sized colonies were introduced into Texas from Guatemala during the fiscal year ending June 30, 1905, and were located at several points and in a variety of soils with especial care as to adequate drainage. More recent importations from Guatemala have suffered from delays en route, owing to restrictions of steamship communications by the New Orleans yellow-fever quarantine. Unfortunately, even the selection of the most favorable localities failed to result in the successful over-wintering of this beneficial ant during the winter of 1905-6, and all of the out-of-door colonies perished. A possible useful rôle for this insect in Texas is therefore seemingly out of the question. There seems to be no doubt, from Professor Cook's observations in Guatemala, of the beneficial action of this ant in the small garden cultures of cotton in the high mountain districts of Alta Vera Paz; and it has during the year been discovered in more accessible localities. It is possible that the insect may have some economic value in some of our subtropical possessions, where the winters will be less rigorous and the climate more suitable than in Texas.

#### OLDER IMPORTATIONS.

The various older importations of predaceous and parasitic insects, which have been referred to in the annual reports of the last few years, have been under observation during the last fiscal year, and maintained substantially the same status. This applies to the Asiatic-ladybird enemy of the San Jose scale (*Chilocorus similis*) and the black scale parasite (*Scutellista cyanea*) as well as the older and better-known predaceous enemies of scale pests of citrus and other plants in California.

#### INVESTIGATIONS OF INSECTS DAMAGING FORESTS.

The investigations of insects damaging forests have progressed in a satisfactory manner under the leadership of Dr. A. D. Hopkins, special agent in charge of Forest Insect Investigations. Numerous

problems have been studied, and a large store of general information upon forest insects has been accumulated.

Although, from an administrative standpoint, this work is carried on independently of the Forest Service of the Department, the intimate cooperation of the previous year has been continued, especially as regards the investigation of insects injurious to forests in the national reserves. Many specimens of such insects and their work, as well as valuable notes, have been sent in by officers of the Forest Service. The cooperation of the Forest Service has also been of assistance in the investigation of the locust borer and of the white-pine weevil.

As heretofore, investigations have principally been conducted in the field during spring, summer, and fall, while the winter months have been devoted to the classification and arrangement of collections, the working over of notes, and the preparation of the more important results for publication, all of the members of the field force returning to Washington in the winter time for this purpose.

#### FIELD WORK.

During the year the greater part of the work has been conducted from field stations, as follows:

Kanawha field station, Kanawha Station, W. Va., by Doctor Hopkins.

Southern field station, Tryon, N. C., by Mr. W. F. Fiske.

Black Hills field station, Custer, S. Dak., and the Rocky Mountain field station, at Centerville, Idaho, by Mr. J. L. Webb.

The northwestern field station, Pialschie, Wash., and the California station, at Wawona, Cal., by Mr. H. E. Burke.

The location of these field stations has been determined by the peculiar advantages offered at those points for the study of some special problem or problems. In addition to the problems of primary importance, others less pressingly in need of solution have been worked upon by the field agent in charge whenever there has been favorable opportunity. Many of these problems have thus received attention from more than one member of the force, and upon some the work of all has been directed. Some of the more important of the investigations under way are as follows:

**BLACK HILLS BEETLE.**—The extension of the ravages of the Black Hills beetle into Colorado and the active interest displayed by certain persons in that State in their desire to check the advance of the insect called for a special investigation, which was undertaken in the fall of 1905. The results were in the highest degree satisfactory, and an account was published in Bulletin No. 56 of the Bureau. Recommendations are now being actively followed by private persons with excellent chances of checking what otherwise might be a most serious invasion. The present summer another investigation was made in June and additional facts determined which complete our knowledge of the life history of the insect within its range and bring about slightly different recommendations for its control at a great saving of time and expense over previous recommendations.

In the Black Hills the situation is not so encouraging. The recommendations of the Bureau, while effective in the portion of the



reserve where they were put into practice, could not be carried out throughout its extent. The result is that a large area of timber which was not injured at the time of the former investigation in 1901 has become badly infested, and much valuable timber has been killed. The importance of the recommendations of the Bureau was not at first realized by owners of property. Moreover, the legal restriction against the shipment of timber out of South Dakota was not promptly amended, and the necessary sale and disposal of infested timber had been delayed. Thus the lack of control of the beetle in the extension of its range is sufficiently explained. These difficulties have now been partially overcome. Especial provision was made in the agricultural appropriation bill for 1906 allowing the shipment of timber from the reserve until 1908, and certain funds have been appropriated for the purpose of carrying out the recommendations of the Bureau. The expenditure of this fund was begun in the spring of 1906, and in April an agent, Mr. Webb, was sent to the reserve to direct operations. The work was greatly hampered from the first by scarcity of labor and was suspended on June 11 on account of lack of funds without enough work having been accomplished to appreciably diminish the force of the next attack of beetles upon trees now healthy. Unless the Forest Service finds it possible to have a large percentage of the infested timber cut during the following fall, winter, and spring, the ravages of the insect will not be controlled.

An important result of this season's investigations has been to demonstrate that the mere peeling of infested trunks is sufficient to cause the destruction of the contained insects up to July, thus adding two months to the period during which this work can be economically carried on. A resident of the Black Hills has devised a tool by which it is possible to bark a considerable portion of the trunk of a tree still standing. By this operation it is hoped the timber may be preserved from decay for a longer period than when the trees are previously cut or when they are allowed to stand with the bark attached.

**THE DESTRUCTIVE PINE BARKBEETLE.**—The investigations by Mr. Fiske of the damage to pine and spruce forests in the Southern States by this insect were continued throughout the year, the results of the past two years largely confirmed, and some new facts of value ascertained. The results have been collected and will form the subject of a bulletin in the near future. Our knowledge of the insect is now very complete except as to its habits of migration, and since recommendations for its control must depend very largely upon this point, the investigation must be continued further. It is not more abundant now than usual in parts of the South where it normally occurs, but there is indication that during the present year it is extending its range farther to the north than it has recently.

**INSECTS INJURIOUS TO FOREST PRODUCTS.**—Investigations on this class of insects have been continued throughout the year, and considerable new information has been gained. Breeding experiments with several species have resulted in a more complete knowledge of their life history, and experiments which will serve as groundwork for more extended experiments in the future have been made with several insecticides. An important point has been gained in the determination of the seasons during which infestation of stored lumber is likely to

occur by the different species. An insect known as *Sinoxylon basulare* has caused the destruction of large quantities of persimmon shuttle blocks in Georgia, and experiments have been made in the way of dipping the blocks in various solutions to prevent subsequent attack, with results that are satisfactory. The cerambycid borers of ash and hickory lumber have been studied, and the life history and habits of the more important species have been determined, together with the seasons of the year during which lumber is liable to infestation by each particular species. Already several lumbermen and millmen have reported good results following the recommendations of the Bureau.

**INSECT ENEMIES OF FOREST REPRODUCTION.**—Beetles of the genus *Pissodes* as enemies of forest reproduction have been studied in the most thorough manner possible, both in the field and in the laboratory. Experiments to determine the effect of systematic pruning of infested trees for the purpose of overcoming the evil effects following the attack of the white pine weevil have been carried on and the results achieved have been encouraging. It has been shown that injuries which might subsequently render the trunks of trees practically worthless may be remedied in this manner, provided the pruning is done within three years after the injury is sustained. By careful systematic work it has been found that the species infesting the terminal twigs of white pine is distinct from that which infests stumps and logs and which was formerly supposed to be identical with it. This is a very important point in connection with the control of the white pine weevil, which is undoubtedly the cause of more injury to the white pine in its natural range than all other insects put together. Another species attacking young Engelmann spruce in Idaho has been studied, and still another whose life history was previously unknown and which kills the young saplings of red fir and Douglas spruce has also been investigated. An account of these insects was published in the Yearbook of the Department for 1905.

**THE WESTERN PINE-DESTROYING BARKBEETLE.**—In compliance with a request by Mr. Gifford Pinchot, Chief of the Forest Service, a preliminary investigation on the cause of the death of pine in the region north of Boise, Idaho, was made in the fall of 1904. This was followed by a special investigation in 1905 at the Rocky Mountain field station at Centerville, Idaho.

This beetle was found to be the principal enemy of the pine in that section, and an account of it, together with recommendations for its control, is now in press.

**FOREST INSECTS OF THE PACIFIC SLOPE.**—The study of the forest insects of the Pacific slope has been continued throughout the year by Mr. Burke at the field station at Pialschie, Wash., and during May and June at the Yosemite National Park at Wawona. Investigations have also been conducted at Summerdale and other localities in California and upon Mount Rainier in Washington. The main object of the work in Yosemite is to learn more concerning the unhealthy conditions of the forests in the National Park in order to form more comprehensive methods for the control of injurious insects. Several species of *Dendroctonus* are attacking the pine and are receiving especial attention, and a species of bark maggot has been

found seriously injuring the wood of the California white fir. A number of other insects of greater or less importance have been investigated.

**NATURAL ENEMIES OF FOREST INSECTS.**—A very extensive series of notes on the parasites and natural enemies of forest insects has been collected in connection with these investigations. The subject has not heretofore been considered as among those of primary importance, and it is perhaps too soon to attempt to utilize the fragmentary knowledge at present available. With increased insight into the habits and host relations of certain of the species new methods by which it might become possible to utilize their aid in a practical manner are continually suggested. As an example, it has recently been discovered that certain species of an important group of parasites which attack a variety of wood and bark boring larvæ may be bred with the greatest freedom in confinement. Their rate of multiplication under favorable circumstances is enormous, and by providing in advance a suitable supply of food it seems likely that very great numbers may be artificially propagated and conveyed to a distance. Experimental work in this direction will be undertaken.

**OFFICE AND LABORATORY WORK.**—The proper care of the rapidly growing collection of forest insects is becoming more and more difficult. Many of the species included are new to science, so that proper identification even of the economically important forms often means a technical revision of the genus or family. Much technical work has been done upon the bark-boring beetles of the family Scolytidæ, upon wood-boring Buprestidæ and Cerambycidæ, and upon other groups as well. The genus *Pissodes* has been revised.

#### INVESTIGATIONS OF INSECTS DAMAGING DECIDUOUS FRUIT TREES.

The work on deciduous-fruit insects, under the immediate charge of Mr. A. L. Quaintance, has been largely a continuation of that already in progress at the close of the fiscal year 1905, namely, investigation of the insects injuriously affecting the peach. Numerous other deciduous-fruit insects have been investigated as opportunity has offered at the field stations and in the laboratory at Washington, D. C. The field stations at Youngstown, N. Y., and at Fort Valley, Ga., were continued until the close of the growing season of 1905. In the spring of 1906 a southern field station was located at Myrtle, Ga., in the midst of a large peach acreage, and a northern field station was located at North East, Pa., in the extreme northwestern portion of the State, in which section there is a large fruit interest. May 1, 1906, a field station was established at Nebraska City, Nebr., for codling moth work.

#### SAN JOSE SCALE INVESTIGATIONS.

Aside from a limited investigation of the parasites of the San Jose scale and a test of the effect of various fertilizers and poisons applied to the roots of infested potted trees, work has been confined to a continuation of last year's experiments on the standardization of the lime-sulphur wash. The work in 1905 indicated the inefficiency of numerous formulas, which were consequently discarded, and indicated the value of others, which were further tested in 1906. Certain



caustic soda-sulphur washes have also been tried, as well as the principal proprietary miscible oils now on the market and concerning which there is considerable inquiry from orchardists. All of these tests have been carried out in three latitudes, namely, Georgia, Maryland, and northern Pennsylvania—on peach in Georgia, and on peach and apple in the others.

An extended chemical study of the lime-sulphur and other washes, undertaken in cooperation with the Bureau of Chemistry, has been practically finished.

#### PLUM CURCULIO INVESTIGATIONS.

In the work on the plum curculio, in addition to careful life history studies, special attention has been given to determining the value of applications of arsenate of lead. The value and expense of jarring on a commercial scale has also been determined for comparison with similar data as to spraying. In the Middle and Southern States the repeated applications of any arsenical to peach, as is necessary to control the curculio, is followed by more or less injury to foliage and fruit, varying in extent apparently with weather conditions. It has been necessary to secure definite information on this matter, and all of the available arsenicals were tested on peach, used with and without lime, and careful notes were made as to the extent of injury. Photographs were made showing the effects of treatment in the defoliation of trees. All of this work was carried on in triplicate at the Pennsylvania and Georgia field stations and on the Arlington Farm near Washington, D. C.

#### PEACH BORER INVESTIGATIONS.

Work with the peach borer was also continued as in 1905, especial attention being given to the life history studies in order to ascertain for the latitudes of the respective field stations the period of emergence of the moths as bearing on the time to make applications of washes and other forms of protection of trees. Some eight or ten different washes and protectors considered most likely to be valuable are being tested. Some time has been given to developing a sticky preparation, consisting largely of cotton-seed oil and resin, which it is hoped will protect and not injure the trees.

#### CODLING MOTH INVESTIGATIONS.

A special investigation of the codling moth in the Middle West was undertaken May 1, in connection with the investigation by the Bureau of Plant Industry of the apple scab. Demonstration in codling moth control was also inaugurated in several counties in southeastern Nebraska, in Missouri, and in Arkansas, in conjunction with similar work by the Bureau of Plant Industry in the control of apple scab and bitter rot. A field station was established at Nebraska City, Nebr., and here especial attention is being given to an investigation of the generations of the insect and the testing of means of reducing injury from the second generation. The demonstration work is in cooperation with orchardists, this Bureau and the Bureau of Plant Industry furnishing plans for the experiments and information concerning the application of the sprays. Labor and necessary chemicals are furnished by the orchardists.

## OTHER WORK.

Several additional insects of deciduous fruit trees have been carefully studied, namely, the black peach aphid, the trumpet leaf-miner of the apple, the peach lecanium, climbing cutworms, canker-worms, and others. Attention is given to the bringing together of as many fruit insects as possible, with examples of their work. Much use is made of the camera in making photographs of insects and their work, and of orchards and subjects related to the investigation.

## COOPERATION WITH EXPERIMENT STATIONS.

The entomologist of the Maryland Agricultural Experiment Station is cooperating with the Bureau in the lime-sulphur work, peach borer, and plum curculio investigations. The Georgia State entomologist is cooperating in the peach borer work and tests of arsenicals on peach foliage. On a plan submitted by the Bureau, the Georgia State entomologist has also undertaken a study of the codling moth in that State. The entomologist of the Tennessee Agricultural Experiment Station is cooperating in the peach borer work, and the Missouri Fruit Station at Mountain Grove in the codling moth work. The horticulturist of the Nebraska Experiment Station is cooperating in the codling moth demonstration work in that State.

## FIELD-CROP INSECT INVESTIGATIONS.

Mr. F. M. Webster, special agent in charge of Field Crop Insect Investigations, has carried on the work outlined in the last annual report, and has taken up several new lines. The most important aspects of his investigations during the past year have been those upon the Hessian fly and those upon joint-worms.

## HESSIAN FLY INVESTIGATIONS.

A further investigation of the distribution of the Hessian fly, except in the Pacific region, has failed to reveal its presence in even limited numbers south of the Arkansas River, in spite of occasional reports to the contrary due to misidentification, and it has been found that it only occasionally extends west of the one hundredth meridian, and then only for a short distance. An assistant has made a very careful survey through the western Dakotas, Montana, Wyoming, western Kansas, Nebraska, Colorado, and Oklahoma, and the foregoing statement is the result of his investigations. On the other hand, it has been found to extend farther south in Georgia and South Carolina than has been supposed, and is troublesome in central Georgia and for some distance south of Columbia, S. C. It also affects wheat nearer the coast in North Carolina than had been supposed. The most serious outbreaks have, however, during this year, occurred on the Pacific coast, where, on account of lack of funds, the Bureau has been unable to study it.

The wheat-sowing experiments, to determine the best time to sow wheat in the fall to ward off autumn attack, have all been continued in the different localities indicated in the last report, namely, Sault Ste. Marie, Bellaire, Clare, Lansing, and Hudson, Mich.; Andover, Rockaway, and New Richmond, Ohio; Richmond, Ind., and Dublin,

Va. One station has been added in western Kentucky, one in South Carolina, and two in North Carolina, in addition to one undertaken in cooperation with the Agricultural Experiment Station at Knoxville, Tenn., and several in Georgia in cooperation with the State board of entomology. Tabulated with reference to States, these experiments are located as follows: Michigan 5, Ohio 3, Indiana 1, Kentucky 1, Tennessee 2, Georgia 3, South Carolina 1, North Carolina 2, Virginia 1. The results obtained have shown more clearly than ever that it will be possible for the wheat grower to so time his seeding in the fall as to evade this pest to a large extent and thus prevent losses. Exact data with consideration of dates will be published.

The effects of meteorological conditions during the few weeks prior to seeding in the fall as bearing upon changes of date of planting, consequent upon immediate conditions of any one given year, have also been carefully studied in collaboration with the Weather Bureau stations in the several States. While it is as yet too soon to give out definite instructions to farmers as to when and when not to sow in the fall—two years being too short a time to determine the precise effects of variations in season—yet farmers are already beginning to profit from the results of these experiments. In the case of fields sown in different localities, the assistants engaged in this investigation are able frequently to tell almost the exact date of sowing, and in some cases, by observing the extent of Hessian fly attack, to collect the data given them by the owners. Thus, while the main facts have already been secured, it will require several years' observation and collaboration in order to acquire a thorough knowledge of the effects of weather, elevation, and possibly other factors not yet developed.

Careful study has shown that the macaroni wheats are almost entirely immune from Hessian fly attack.

THE HESSIAN FLY IN THE SPRING-WHEAT REGIONS.—Investigations of this subject have been continued, and as nearly as can be told from the records of two similar years, the life history of the fly is fully established. This is of great value, since from what we know of the life history of the insect in winter-wheat regions it had seemed practically impossible for the species to exist in any number in territory planted exclusively to spring wheat. There has been, therefore, in spring-wheat infestation, a decided change in what was considered to be the normal life history of the insect. In short, the Hessian fly problem in spring-wheat regions is so different from that in winter-wheat regions that we are obliged to take it up as though we were dealing with a new pest. While it is as yet too soon to begin to lay down rules for the guidance of the farmer, it is safe to say that at least one measure so efficient in warding off attack in fall wheat, namely, late sowing, must here be reversed, and the earlier the crop is sown in the spring the less liable it will be to fly attack. And then, too, spring wheat will send up shoots or suckers from the old roots after the straw has matured, and the pest will breed on these as freely as on the original growth when young. Winter wheats do not have this habit. Ensnared in these suckers or in volunteer wheat larvæ in protected situations will continue to live and develop even when the temperature at night occasionally falls to  $+4^{\circ}$  F. This kills off most but not all of the young larvæ up to the half-grown condition. This



aftergrowth not only tends to protect from severe cold, but greatly modifies the effect of burning the stubble.

*Parasites.*—The investigations seem to show at the present time that the success or failure of spring-wheat culture north of central Iowa and the Platte River depends upon two very minute parasites, namely, *Polygnotus huachuca* Ashm. and *P. hiemalis* Forbes. But for these two insects the Hessian fly would render wheat growing impossible in this section. They deposit their eggs in the eggs of the Hessian fly, and the adults emerge from the pupæ or "flaxseeds," as many as 28 parasitic larvæ having been found in a single "flaxseed." Where these parasites swarmed in the fields during the summer of 1905, no adult Hessian flies have been found this season by sweeping, and so effective have they been in suppressing the Hessian fly about Tower City, N. Dak., that the field agent in charge of the work at that point, Mr. G. I. Reeves, has been obliged to go to Fessenden, where he was unable to find these parasites last year, in order to get unparasitized "flaxseeds" with which to follow out some of his more delicate experiments. These are the parasites which we tried to introduce into Kentucky and Tennessee and also into California last year. Whether they have established themselves in these localities we are not yet aware. Owing to lack of funds and assistance, the results of this parasite work can not be followed up at present. It is quite possible that had the Bureau been able to establish a field station on the Pacific slope, any number of these parasites could have been rushed to the outbreak in the State of Washington, where the wheat crop is being so badly affected that the local authorities have advised the burning of wheat in the field to destroy the fly.

It has been demonstrated in the laboratory at Washington, D. C., that these parasites can be retarded or accelerated in their emergence by controlling the heat and moisture. On a large scale this can in all probability be done by cold, dry storage and hot, humid field conditions. It has been shown that these same parasites were equally effective in the winter-wheat regions.

#### JOINT-WORM INVESTIGATIONS.

It has been ascertained that the timothy joint-worm reduces the seed crop from 5 to 18 per cent and injures the hay crop to a less degree. The intensity of attack seems to vary in proportion to the time the ground has been continuously planted with this grass. The insect occurs over the entire country of the United States east of the Rocky Mountains wherever timothy becomes the principal forage crop. A new and undescribed parasite is increasing rapidly over nearly this whole area.

A large series of experiments has been carried on by an assistant, Mr. W. J. Phillips, to determine whether this insect infests the uncultivated grasses and is therefore likely to spread from these to meadows, or whether there are any migrations between such grasses and the cultivated grains.

An enormous amount of material has been bred from all sections of the country, and many species of joint-worms are found. A number of them, still undescribed, are found to be engaged in grain and grass attack.

An interesting and seemingly valuable parasite of the wheat joint-

worm, belonging to the genus *Cryptopristus*, is rapidly increasing in abundance in the East and seemingly pushing its way westward. It is two-brooded, and develops one generation before and one after harvest. From wheat stubble collected in Michigan an average of a little over nineteen parasites issued to one joint-worm, and from a bunch of stubble collected at Kensington, Md., the proportion was one joint-worm to thirty-one parasites.

Important studies were made to determine the effect on the wheat joint-worm of passing the straw through a thrashing machine. Heretofore it has been thought important that the broken hard bits of straw that contain the joint-worm should be burned to destroy the pest. The results indicate that the action of the thrashing machine is fatal to a large percentage of the insects and that the danger from the broken hardened bits of straw in fields, barnyards, and about elevators has been overestimated.

#### MISCELLANEOUS INVESTIGATIONS.

Studies have been made of clover-seed and clover-root insects, and two circulars of information have been issued. Studies of the corn root-louse, which is at present one of the most serious pests of the cornfield, the southern corn root-borer, the smaller corn stalk-borer, and the southern corn leaf-beetle have been made. A serious cut-worm injury to corn in western Pennsylvania and Ohio and serious ravages of a carabid beetle, *Clivina impressifrons*, in the Middle West have been studied.

#### WORK ON INSECTS INJURIOUS TO VEGETABLE CROPS.

Investigations on the insect enemies of vegetables and other truck crops have been continued by Mr. F. H. Chittenden along the same lines as conducted in previous years. Lack of funds has rendered the practical results less valuable than should be the case. The expert in charge of this line of investigation has been practically without assistance during the fiscal year.

The subject of insects injurious to sugar-beet culture in the West, which was taken up as a special topic for investigation in recent years, has been continued. A very destructive leaf-hopper (*Eutettix stricta*), known locally as the white fly and the blight, the latter name being due to the effects of its operations on sugar beet, was the cause of serious damage and much complaint in Utah, Idaho, and Colorado. A special agent was employed in cooperation with the Utah State Experiment Station to study the conditions and to devise means for its suppression in the infested district. A considerable proportion of the species of sugar-beet insects observed and collected in 1904 have been worked up, but the work on the life history of the remainder will still require some time to complete.

The continued spread of the asparagus beetles westward and northward has rendered it necessary to revise a popular article on these insects, published in the Yearbook for 1906, for use as a Farmers' Bulletin.

Additional observations have been made in regard to the pepper weevil, a new pest in this country, related to the cotton boll weevil and occupying a similar region. These results are available for publication.

Root maggots, which have been unusually destructive since about 1903, have been under continuous observation, and some species which have never before been fully investigated have been the subject of special study. One form in particular has done great damage in Alaska, and through the kindness of correspondents and the cooperation of Dr. C. C. Georgeson, special agent in charge of the agricultural experiment station at Sitka, some facts not previously recorded in regard to this insect have been gained. Owing to the coldness of the climate in Alaska the insect makes its appearance considerably later in the season than in the principal infested districts of the Eastern and Middle Western States.

The common stalk borer (*Papaipema nitela*) has been under especial observation during the year owing to its recent severe depredations. The egg-laying habit and the hibernation of the insect in the egg stage, as well as other data which have been accumulated, are all of value in indicating methods of control. Practical exemplification of the utility of these methods has been had. A comprehensive account of this and related forms is in course of preparation.

The melon aphid has been the subject of practical experiments, especially in Texas, in cooperation with the Texas Agricultural Experiment Station. A method of controlling this insect on its first appearance in the fields of melon, cucumber, and other cucurbits has been devised and is now being perfected. It consists in fumigating the plants with nicotine preparations, which give instant and, if continued, permanent relief against the ravages of this serious pest. A comprehensive, general, and economic account of this species, with directions for its control by this and other methods, is nearly complete and will soon be published. A frame method of fumigation by means of nicotine preparations will be found applicable to other forms of plant lice affecting vegetable crops, as, for example, the cabbage aphid, which is a pest locally in certain years.

Other species studied are certain forms of cutworms, the tobacco flea-beetle, and the larva of the striped turnip or cabbage flea-beetle, responsible for a new form of injury to radishes.

#### INVESTIGATIONS OF INSECTS IN THEIR DIRECT RELATION TO THE HEALTH OF MAN AND DOMESTIC ANIMALS.

The work of the year in this direction has comprised investigations of three kinds, namely, work on mosquitoes, work on the house fly, and work on the Texas cattle tick.

##### MOSQUITOES.

During the first few months of the fiscal year under consideration the outbreak of yellow fever in certain of the Southern States once more drew attention to the yellow-fever mosquito, and, as indicated in the last report, the work previously done by the Chief of the Bureau in regard to the geographic distribution of this dangerous insect was extensively used by the Public Health and Marine Hospital Service in basing its recommendations in regard to quarantine measures. On the return of the Chief of the Bureau in August from Europe, where he had been engaged arranging for the importation of the parasites of the gipsy moth, he took up a further study of the



yellow-fever mosquito, and in the autumn visited New Orleans and portions of Texas in pursuance of this work. Some new and important points relating to the habits of the species were ascertained, and some valuable experiments were made with remedies and methods of destruction, both in the larval and adult conditions.

Further work on mosquitoes has been carried on throughout the year in cooperation with the Carnegie Institution of Washington, and very complete records have been brought together of the life histories and geographic distribution of nearly all of the mosquitoes inhabiting North and Central America and the West Indies. The information thus gained is being brought together in monographic form, and when published it is hoped that it will be of value to the medical profession and form a sound basis for the identification of species, the determination of their disease-bearing possibilities, and for general information to all interested.

#### THE HOUSE FLY.

In the spring of 1906 a publication was issued on the subject of the house fly, calling attention to its agency in the spread of typhoid fever, pointing out the proper methods for its control, and urging the adoption of these methods by individuals and communities. The unusual spread of typhoid in the city of Washington during the summer, following as it did the complete installation of the elaborate water-supply filtration plants—an occurrence unique in the history of sanitation—drew marked attention upon the house fly once more as one of the causes, although not the principal one, of the transfer of this disease. Based partly upon the investigations of the Bureau, the health authorities of the city issued in May an order respecting the proper care of stables (where house flies breed), but were unable, through lack of a sufficient inspecting force, to carry the regulations into effect. Observations were made by the Bureau, partly in cooperation with the health officer, upon a series of stables in two different regions of the city, and it was shown on a somewhat large scale that it is a comparatively easy matter greatly to reduce the numbers of the house fly in any given community at a comparatively slight expenditure of funds and effort. These facts will be displayed in a revised edition of Circular No. 71 of the Bureau.

#### WORK ON THE TEXAS CATTLE TICK.

As indicated in the last report, the Bureau of Entomology has for some time been urged by southern entomologists and cattle raisers to undertake work on the cattle tick. This was begun at the close of the fiscal year 1905 and continued throughout the fiscal year 1906 in connection with the investigation of the cotton boll weevil. Prof. H. A. Morgan, director of the Tennessee Experiment Station, who has done more work on the biology of the cattle tick than anyone else in this country, furnished the Bureau with a very large amount of his unpublished notes and also his suggestions and advice as to the lines which could be followed with the best promise of practical results. The work done by the Bureau has been planned in such a way as to furnish the information about the tick which is absolutely necessary in the so-called pasture or field-lot system of eradication. In order

to follow these methods intelligently, it is necessary to have information concerning the length of development of the different stages under different conditions of host, climate, and season. It is also necessary to ascertain by what means dissemination of the ticks takes place—that is to say, whether floods, winds, or animals other than live stock may be responsible for introducing ticks into new regions. The cooperation of the entomologists in the States of Louisiana, Arkansas, Alabama, Tennessee, and South Carolina was gained. Throughout the season material was sent to them from the laboratory at Dallas, Tex., and outlines were also prepared there in order to bring about uniformity in the work. At Dallas a steer was obtained, and during the season six full generations of the tick were raised upon it.

This work has already considerably increased our knowledge of the development of the tick. In addition to this work, it was found possible, incidentally, to investigate the life history and habits of a number of other common ticks which are likely to be confused with the fever-transmitting species. Some of these other ticks are rather serious pests, and in some cases may be found to transmit diseases. This work, however, has been made strictly secondary to the work on the true Texas cattle tick (*Boophilus annulatus*).

In February, 1906, an agent was placed in the field to canvass the situation in the Gulf States. The work assigned to him has been to obtain data as to the damage done by ticks and to inform farmers as to the proper local methods of eradication. He succeeded in inducing a number of farmers to start systematic plans for freeing their property of ticks. At the same time he obtained information regarding tick-free areas within the quarantine area. Such areas should be utilized in freeing the cattle of surrounding regions from ticks. It is consequently of the greatest importance to find where these tick-free areas are located and their exact extent. One such area of considerable size in Texas, the presence of which had hitherto been unsuspected, has been found.

#### WORK ON SCALE INSECTS.

No especially notable outbreak of scale-insect damage has characterized the last fiscal year. Nevertheless the common scale enemies of orchards and ornamentals have been continually in evidence, and a great deal of infested material has come to the Bureau for examination and determination. This applies particularly to such standard scale pests as the oyster-shell scale of the apple and pear and other plants and the scurfy scale affecting the same range of plants. The oyster-shell scale or "bark-louse" has been particularly frequently reported the present year as affecting ornamentals, practically all deciduous plants being subject to attack by it. Injury from this species has been very notable this year in western New York, and also in Massachusetts, on ornamentals and shade trees and to a less extent perhaps on fruit trees. The cottony scale of the maple (*Pulvinaria innumerabilis*) is also reappearing, but will probably be less abundant this year than last, and the belief that it will eventually be brought in subjection by its native ladybird enemy (*Hyperaspis signata*) is apparently well founded. This little ladybird developed in enormous numbers last year and should be therefore so abundant this year as to give a very good account of itself

in the reduction or perhaps almost complete extermination, for the time being, of its host insect. The San Jose scale continues to be the most important scale pest in this country and has been the subject of careful investigations with remedies and from the standpoint of natural enemies. Bulletin 3 of this Bureau, published more than ten years ago, has been thoroughly revised for reissue to bring the subject down to date. It will be published as Bulletin 62.

In Florida the white fly continues to be a very serious pest of citrus cultures, and a special appropriation has been asked for and granted by Congress of \$5,000 for a thorough investigation of this pest.

A good deal of time is devoted during the year to thorough inspection of all the new plants which the Department of Agriculture is importing from different parts of the world to detect and destroy any new insect enemies which might be brought in with them. The insect enemies likely to be brought in such plants are principally of the scale-insect family, and the careful examination which is given to such material has resulted in the destruction or thorough fumigation of a good deal of material which would otherwise have been the means of introducing important new enemies.

The laboratory investigations, particularly the determination of material for experiment stations and individuals throughout the country, is a constant feature of the work, and takes much of the time of two expert assistants. This work is under the direction of Mr. C. L. Marlatt.

#### WORK ON INSECTS INJURIOUS TO STORED PRODUCTS.

There has been constant correspondence in regard to insects of this class, and a constant distribution of circulars of information describing the most prominent forms. The Mediterranean flour moth continues its spread throughout the northern United States, where it now appears to be generally distributed in all of the principal milling districts from the Atlantic to the Pacific. Although this species has been given very considerable study in this office by Dr. F. H. Chittenden, who is in charge of this branch of the work, and in some of the States where it is most injurious, there is still much to be learned in regard to the effect of certain fumigation methods in its control. This, and other species injurious to stored products, can be destroyed by the use of hydrocyanic-acid gas, which has some advantages over bisulphide of carbon, one of which is that it can be used where the latter can not, on account of objections made by insurance companies issuing policies on the premises invaded. Circulars have been distributed describing the use of hydrocyanic-acid gas. This substance has the objection of danger to human life, except where the utmost care is taken, and investigations are being made with other substances not inimical to human beings.

#### EXPERIMENTAL WORK WITH INSECTICIDES.

A certain portion of the work of this class has already been mentioned under the head of "Investigations of Insects Damaging Deciduous Fruit Trees," although the general subject is placed under the management of Mr. C. L. Marlatt, the assistant chief of the



Bureau. Aside from this the particularly new work during the fiscal year 1906, alluded to as begun in the last report, has been careful experimentation with sulphurous-acid gas ( $\text{SO}_2$  and  $\text{SO}_3$ ), for the disinfection of granaries or other storages of grains or seeds, or for the disinfection of dwellings and similar uses. These tests were carried out on a very liberal scale and in a very thorough manner, and fully demonstrated the field of usefulness for this gas. A report on this experimental work is now in process of publication.

The routine work has been carried on during the year, covering species tests with standard insecticides, the fumigation of mills, granaries, and dwellings against insect pests, and the examination and report on the many new insecticide ideas or decoctions which come to the Bureau for attention almost daily. Nine-tenths of these supposed means of insect control are either useless or a reproduction of methods, with or without modifications, which are already well known. Nevertheless the examination of these substances and the correspondence relating thereto takes up a good deal of time.

In the case of the treatment of orchards with insecticides for various insect pests, a great deal of experimental work has been done with the lime, sulphur, and salt wash, twenty different formulas being tested in three localities in as many States. Similar tests have been made in the same localities with the so-called miscible oils. These tests all relate to the control of the San Jose scale.

#### WORK IN BEE CULTURE.

There has been a decided increase in the work in this branch during the past fiscal year, due in no small part to the increased interest in the investigations on the part of honey producers of the United States.

A large number of queen bees of different varieties were reared and distributed from the apiary at Washington, D. C., as well as from the substation at Chico, Cal. The plan for this distribution has been modified so that it is no longer promiscuous, but the queens are placed with men who are in position to propagate desirable stock and distribute it widely among the bee keepers of the country. The Caucasian race received the most attention. A stock of this race is now offered for sale by reliable dealers, most of whom have received their stock through the Bureau. Cyprian and Carniolan queens have also been sent out.

Investigations of the giant bees of India and the Philippines were continued during the year, and Mr. Frank Benton, in charge of the work, has from time to time since reaching India sent in reports of these bees. The results of this work should be known to the Department within a few months.

The various methods of queen rearing were tested in rearing queens for distribution, and a bulletin entitled *The Rearing of Queen Bees* was written by Mr. E. F. Phillips and has been quite widely distributed upon application from persons interested. It deals with the modern methods of queen rearing and brings together our knowledge upon the subject.

During the year Mr. Phillips, in charge during Mr. Benton's absence, attended various bee keepers' conventions and delivered

addresses in cooperation with the New York State Department of Agriculture and the Pennsylvania State Bee Keepers' Association.

The substation at Chico, Cal., with Mr. J. M. Rankin in charge, was continued, with results which are all that can be expected with the present limited facilities for the work. The principal work was on the honey-producing plants, and this was done in cooperation with the Bureau of Plant Industry. The results obtained are in no small part due to the great kindness of Mr. P. H. Dorsett, of the Bureau of Plant Industry, who is in charge of the plant-introduction garden at Chico, Cal. A considerable number of plants have been propagated which are remarkable honey producers. During the previous fiscal year the seeds of certain honey-producing plants were distributed to a number of bee keepers throughout the United States. The reports received during the last year, however, showed that with few exceptions they were of little value.

#### BEE DISEASES.

The work on brood diseases of bees occupied a considerable proportion of the time of the force. The bacteriological work connected with the investigation was done by the bacteriologist assigned to this subject in the Bureau of Animal Industry. As a result of this investigation, the confusion which has existed in regard to brood diseases has been to a certain extent cleared up, and the work of fighting these diseases will be benefited by the added information.

A trip of investigation of bee diseases, particularly the one commonly known as black brood, was made through New York State in the spring of 1906, and proved to be very valuable. The trip was made in cooperation with the four New York State inspectors of apiaries.

In the late summer of 1905 the California agent made a preliminary investigation of the disease known to bee keepers as paralysis, in the San Joaquin Valley, California. A large number of samples of diseased brood from various diseases have been diagnosed.

#### ROUTINE WORK.

The correspondence in bee culture has practically doubled within the year. Card catalogues have been prepared of queen breeders, dealers in apicultural supplies, and bee-disease inspectors; the mailing list has been completely revised, and an index of American bee literature has been made.

#### WORK IN SILK CULTURE.

The silk-culture work of the Bureau has been continued in almost exactly the same manner as during the previous fiscal year. Mr. C. J. Gilliss has had immediate charge under the Chief of the Bureau. The correspondence has increased to a certain extent, and nearly 3,000 letters were received. The interest exhibited by correspondents seems, as in the fiscal year 1905, to have been most marked in the State of New York, but during the fiscal year 1906 California has shown a greatly increased interest. The other principal centers of interest seem to have been Illinois, Massachusetts, Michigan, New Jersey, Ohio, and Pennsylvania. There was decreased correspond-

ence in most of the Southern States. This does not mean, however, that there has been an actual decrease in the number of persons raising silk in this region, since in some cases we know that the raiser has produced his own eggs and has begun work in producing cocoons without recourse to the Bureau. It is interesting to note that the direction of increase in interest follows the line of publication of syndicate articles on the subject of silk culture in the newspapers. The course of certain of these articles has been traced, and it has been shown that this year they traveled in a line from the New England States to California, following the northern boundary of the country, while little or nothing has been published in the Southern States.

#### PURCHASE OF SILKWORM EGGS AND THEIR DISTRIBUTION.

As in previous years, the egg supply has been bought in Europe, from well-known houses, where the latest methods for the detection of disease are practised, and from which eggs are sent out only under guaranty of health. Eighty ounces were imported from Italy in this way. In addition to these some 20,000 eggs of a new race were donated to the Bureau by an Italian firm and some 40,000 were sent in by Consul Young from Harput, Turkey, with the information that they were of a race commonly used for importation into Russia and Prussia. The Italian eggs were sent to Barnegat, N. J., and the Turkish eggs to Florida. The latter having arrived in February and having been found to be nearly all hatched, it was necessary to send them to a southern point, since no leaves could be obtained in the North.

HOME PRODUCTION OF EGGS.—Although the Bureau has never encouraged the home production of eggs, and, in fact, has urged that they should not be produced at home, showing the discouraging effect on the industry, it seems almost impossible to prevent it. In fact, fully one-third of the individuals sending in cocoons have not received eggs from the Department. Of course one way to effectually discourage this practice would be not to buy cocoons from such persons, but the Bureau hesitates to take this extreme course until positive proof of the existence of disease among home-raised eggs is gained.

HEALTH OF EGGS.—Careful watch has been kept for traces of pebrine, but no new cases have been noted. It still continues to exist at an establishment in Cuba. The person in charge was directed to take precautionary measures, fumigating rearing rooms and materials, and later, as the disease grew worse, he was advised to discontinue raising silkworms for one year. He has been requested to send no samples of cocoons or anything connected with silk raising to this country. At one place in California where it existed last year it is thought now that it has been stamped out.

Careful experiments have been made as to the effects of cold storage on eggs, and it has been noted that for eight months there are apparently no ill effects and no weakening of vitality. It was confidently expected that they might therefore be safely left for at least twelve months, but during the ninth month a change took place; the eggs began to lose their plump appearance and the ends to sink in. At twelve months not more than one egg out of several hundred could be induced to hatch, and at fourteen months none at all.



**DISTRIBUTION OF EGGS.**—In the winter and spring eggs were sent to 413 individuals in 47 different States and Territories, as against 356 individuals in 42 States and Territories during the previous fiscal year, showing a slight increase in interest.

#### DISTRIBUTION OF MULBERRY STOCK.

As in the previous year, seedlings of the best white mulberry were distributed to all applicants during the late fall and spring, none being sent out during freezing weather. Last season (1905) 48,560 seedlings were distributed and this season (1906) 34,575. The seedlings of this season, however, reached a much larger number of correspondents, since the trees were sent out in smaller lots. Excellent results are reported from all quarters regarding the growth of the trees, which would seem to indicate that they are of the finest quality. The States receiving the most were California, Illinois, Virginia, Michigan, Wisconsin, New York, and Connecticut.

Four kilograms of mulberry seed have been purchased in Lombardy for next season's supply of seedlings—1 kilogram of a Sicilian variety and 3 kilograms of a Lombardian variety.

The mulberry orchard at the Arlington Farm has been carefully attended during the year, and the new orchard planted to several acres last year has been enlarged by  $1\frac{1}{2}$  acres.

#### COCOONS PURCHASED.

Between July 1 and October 4, 1905, American-raised cocoons were purchased, whenever offered for sale, at the rate of from 75 cents to \$1 per dried pound, the producer being required to pay transportation charges. On October 4 the rate was raised 15 cents per pound on all classes. In addition the Government assumed the expense of transportation, providing franks to be sent to producers on application. The end of the fiscal year, however, found a falling off in the number of pounds of cocoons offered for sale as compared with the record for the previous year. An encouraging fact, however, as opposed to this is that the quality of the cocoons has greatly improved, and it is hoped with some grounds that the quantity of the cocoons offered will be considerably increased the coming year.

#### REELING OPERATIONS.

Reeling has been carried on in the same manner as formerly, with the one 4-basin Berthaud machine in use, there being no available space for setting up the second machine. At the end of the fiscal year 1905 reeling was being carried on with four operators at the basins and one at the beating device. At the end of November the reel was shut down, owing to lack of cocoons, and was resumed in February, 1906. It was shut down again in April and started again about the middle of June. Four, five, or six threads have been used, according to the skill of the operator and the nature of the cocoons employed.

Under the present system the greatest amount of cocoons which can be reeled in a day by one operator is  $1\frac{1}{2}$  pounds. This might be increased to 2 pounds daily if all the cocoons were of a good quality.

The amount of reeled silk turned out is about 1 pound for each  $3\frac{1}{2}$  or 4 pounds of cocoons, sometimes dropping lower if especially poor cocoons are used.

Samples of the silk reeled were submitted for expert examination, and were discovered to be inferior to the best, owing to lack of skill on the part of the operators. The samples submitted were graded as Ardeche Classical silk, which ranks as the second grade of Cevennes silk.

#### MISCELLANEOUS INVESTIGATIONS AND OTHER WORK.

Several investigations of importance have been carried on which will not fall under any one of the headings so far used, and of these the principal ones may be summarized here.

Work on insects injurious to strawberry, and raspberry, blackberry, and other bush fruits has been continued, and a difficulty which has presented itself from time to time, namely, the identification of certain injurious forms whose names were generally confused, has been satisfactorily settled, and articles on some of these species will shortly appear. Prominent among these are several forms of leaf-rollers, root-worms, and related forms. One of these pests, known as the strawberry crown-girdler, has become a great pest during the year in portions of the State of Washington, and investigations have been begun looking toward better methods of control than are known at present.

A very considerable number of insects injurious to flower gardens and in greenhouses have been studied, both in the city of Washington and by cooperation of correspondents. A special study of the insect enemies of roses has been under way, and it is hoped will soon be completed.

The corn root-aphis in its occurrence upon dahlia, aster, and related composite plants has been studied.

Many complaints are received each year of insect injury to shade and ornamental trees. The chief tree defoliators have been treated in publications now available, and some of the borers have been considered, but considerable progress has been made in methods of treating these pests, particularly the latter class, and work which has been carried on for some time on the principal insect enemies of shade trees will be pushed rapidly forward to the end of a publication of a comprehensive account of these pests. Among the shade-tree insects which have greatly extended their range of injuriousness and which require special treatment are the imported willow or poplar curculio, the willow leaf-beetles, the bronze birch borer, and the greenhouse red spider, which latter has become a pest of some seriousness on shade trees. This leaves out of account the gipsy moth and brown-tail moth, which are the subject of investigations to be paid for from funds provided by Congress for the fiscal year 1907.

An investigation of the habits of the gadflies of the family Tabanidæ has been completed, and a special report is about to be issued.

The correspondence of the Bureau has increased, necessitating an enlargement of the clerical force. More than 30,000 letters were written during the year, and many queries were answered by the aid of circulars.

The routine work in the insectary has increased also, and biological studies have been made of nearly 500 species not hitherto studied, and the biological numbers now reach 11,688, each number

meaning that a distinct species has been studied from time to time in the insectary and notes made upon its life history.

The work of determining specimens for the entomologists of the State experiment stations and other workers has also increased. Many thousands of insects have been received from these workers, and a certain proportion of the time of a number of expert assistants was taken up in this way.

#### PROPOSED WORK FOR THE FISCAL YEAR 1907.

The work for the fiscal year 1907 is, at the date of this writing, already well under way, and will consist for the most part in following out the lines of investigation just indicated.

Two new lines of work, however, of great importance have been added during the present fiscal year. The first of these, an investigation of the white fly of Florida and the Gulf regions, has been started by the assignment of a trained entomologist, Mr. A. W. Morrill, in charge, under the direct supervision of Mr. C. L. Marlatt, Assistant Chief of the Bureau, who has general charge of insects affecting tropical and subtropical fruits. The white fly is an insect which has done very considerable damage to the orange and lemon groves of Florida and which has been spreading and increasing. The agent in charge has made a preliminary investigation and has established headquarters at Orlando. Every possible phase of the life history of the white fly will be investigated, and careful work will be done on the remedial side.

The second new investigation of importance is that of an effort to prevent the further spread of the gipsy moth and the brown-tail moth in New England. There is a radical difference in the possibilities of effective work for the prevention of the spread of these two insects. The brown-tail moth flies readily in both sexes and has already covered a very great extent of territory, ranging from Amherst, Mass., to a point high up the Maine coast. At the time of its annual flight it is carried by the prevailing winds possibly for hundreds of miles, and an effort to prevent its spread seems hopeless except by the active cooperation of every property holder within the infested territory. The means by which it may be destroyed, however, are simple. Its winter nests are conspicuous objects on the terminal twigs of trees and shrubs in the winter time after the leaves have fallen, and it is a simple matter to cut them off and burn them, every one destroyed meaning the death of 250 caterpillars on the average. The campaign against this insect, therefore, must be in the first place an educational one, and in the second place one of local effort to enforce its destruction. The principal measures are therefore local or State police measures. The Bureau will do all that it can to assist in the educational part of the movement and will endeavor to assist State authorities and communities to carry out the work of destruction.

With the gipsy moth, however, the case is different. The female can not fly, and the species is distributed by means of the caterpillars, which, spinning down from trees overhanging roadsides, are carried long distances by automobiles, carriages, trolley cars, and other vehicles, and shorter distances by pedestrians. The plain method of preventing its further spread, therefore, is to exterminate the



insect upon roadside trees in the thickly infested centers. The main center of infestation is at the present time eastern Massachusetts, the territory from Worcester to the coast being well covered. The range extends continuously north into New Hampshire and probably beyond into southwestern Maine.

There are two isolated colonies, the one in the city of Providence and the other at Stonington, Conn. By cooperation with the State authorities the Bureau will endeavor to stamp out the isolated colonies in these two States. Further than that, it will during the coming autumn and winter endeavor accurately to determine the exact localities in which the insect exists in the States of New Hampshire and Maine. But the main work in preventing the further spread will be done in the State of Massachusetts, by cleaning up the main thoroughfares leading out from the regions of thickest infestation.

Headquarters have been established at Boston, a trained man, Mr. D. M. Rogers, has been put in charge of the work, and gangs of men are already engaged in the roadside cleaning. This work will be continued throughout the fiscal year.

The importance of the continuation of the experimental work on the boll weevil has been pointed out elsewhere. The pest is invading new regions, where the local conditions must give the problem of its control aspects entirely different from those represented elsewhere. In Texas the cultural method of controlling the pest has been found to be effective. This is to a large extent due to the comparatively small rainfall. In the localities where the rainfall has been greatest damage has always been most severe. In the Red River Valley in Louisiana and the Mississippi Valley the general conditions are exactly like those which have caused the greatest difficulty in controlling the insect in Texas. In some localities in the latter State it has been necessary to substitute other crops for cotton. In Louisiana, where similar conditions prevail, on account of industrial conditions it will be impossible for the planters to dispense with the cotton crops. Accordingly, the problem of weevil control in the regions into which it is just entering is by no means solved. The annual precipitation averages 20 to 25 per cent greater than in Texas. Moreover, the more or less general situation of the cotton fields near timber, affording abundant opportunities for successful hibernation, also adds to the difficulties of the problem.

At various times the suggestion has been made that instead of early planting, as advocated by the Bureau and successfully practiced by a large number of planters, late planting might under some conditions be more feasible. This idea has been based upon the heavy mortality of hibernating weevils. It has been supposed that by the fall destruction of the plant and the preventing of the maturity of late broods by late planting, the period of hibernation would be so prolonged that no weevils would survive. Although a large amount of experimental evidence already in possession of the Bureau tends to show the fallacy of this theory, it has been planned the present year to greatly augment our information. In order to accomplish this, after considerable search six isolated fields have been selected at points in Texas and Louisiana which will give a great variety of climatic conditions. On the fields which were finally

selected the planting of the crops was deferred until about the 10th of June. At the end of the season the Bureau will have complete information regarding the possibility of evading the weevil by late planting. As a matter of fact, it has already been found that late planting is a failure in one instance, since considerable infestation has been found in a field planted on the 10th of June in Llano County, Tex. It is to be noted that the hibernation experiments mentioned elsewhere also have an immediate bearing upon the theory of late planting. In the cages at Keatchie the weevils which were placed there November 18 were found not to have emerged until the 27th or 28th of June.

The need of more extended experiments than have hitherto been possible in the practical effect of fall destruction of cotton stalks in fields has been evident for some time. A great deal has been done by the Bureau in this direction, but the practice has not been taken up by the planters to the proper extent. During 1906 it is planned to carry on large-scale fall destruction experiments which will serve as a practical demonstration to the farmers in at least two localities. Two rather favorable locations have been found—one in Calhoun County, Tex., and the other in Cameron Parish, La. In each case about 400 acres of cotton have been found completely isolated. The early destruction of the stalks will be begun in September, 1906.

The Bureau will pay very especial attention to the possibility of controlling the weevil in the eastern portion of the cotton belt. Much of the work being done in the laboratory will throw light on this problem.

Especial attention is being given to the adaptation of the weevil to climate and food conditions and protection, as well as the relation between climate, enemies, and food supplies in the multiplication of and injury by the pest.

During the present year experimental work will also be conducted, especially in regions where the greatest damage is certainly to be expected. This has been arranged by reducing the number of experimental farms in Texas and the curtailing of the acreage in others.

In regard to the importation of parasites the work on the introduction of the European parasites of the gipsy moth and the brown-tail moth will be continued throughout the year. Additional sendings from all parts of Europe of the brown-tail moth nests will take place during the autumn and winter, and with the opening of the season of 1907 both species in all stages will be sent over by paid and volunteer agents.

Other beneficial European insects, including parasites, will be imported, and the Assistant Chief of the Bureau, Mr. C. L. Marlatt, is at the time of this writing in Europe engaged upon this mission.

Experimental work upon the kelep, or Guatemalan ant, will be practically discontinued, since, as shown elsewhere, little is to be expected from this ant in the southern United States.

In the work on forest insects the investigations outlined in the previous part of this report will be continued with a reserve fund held for the investigation of any new outbreaks of insects of this class.

In regard to deciduous-fruit insects, it is planned to continue the investigations of the plum curculio, peach borer, and miscellaneous

peach insects. The test of the lime-sulphur wash, in progress for two years, it is hoped may be concluded, at least in its present scope, by the fall of 1906.

The experimental and demonstration work with the codling moth in the Middle West is to be continued, but headquarters may be changed from southeastern Nebraska to southern Missouri, where the fruit interests are more extensive.

In the field-crop insect work the wheat-sowing experiments are all to be continued except at the station in extreme northern Michigan, which will be abandoned. The eastern coast series will be extended northward to Canada in cooperation with the Pennsylvania and New York experiment stations. The North Dakota station will be changed to Manhattan, Kans. A special investigation will be made in the matter of invasion of reclaimed areas in the West by corn and forage-crop insects, following the work of the Reclamation Service. It is hoped also to take up the study of alfalfa insects and western corn insects. A substation will be established near Annapolis Junction, Md., where some of the breeding will be carried out and important field investigations undertaken.

The work on mosquitoes and house flies will be continued in a small way, but further investigations into the cattle tick must be dropped owing to the lack of appropriations for the purpose.

In bee culture especial attention to the subject of bee diseases will be given, and it is planned to have a meeting of the official inspectors of apiaries of various counties and States for the purpose of discussing the various methods of treatment under different climatic conditions, as well as the form of law which best enables the bee keepers of a given State to carry on the work of the extermination of diseases. Should the importation of the giant bees of India and the Philippines be successfully completed during the present fiscal year, steps will be taken for the propagation of these bees and eventually for their distribution. The distribution of queen bees by the Bureau will be discontinued, except in so far as it is possible from time to time to assist queen breeders in the improvement of their stock. The work of procuring and testing valuable honey-producing plants will be continued at the California substation, and an investigation of the comparative value of different races of bees in fertilizing the red clover will be undertaken in cooperation with the expert in charge of cereal and forage-plant insect investigations.

The other investigations under way will be carried on and new ones begun in case of unexpected insect outbreak.

#### **SUGGESTIONS AS TO WORK RECOMMENDED FOR THE FISCAL YEAR ENDING JUNE 30, 1908, FOR USE IN PREPARING ESTIMATES.**

It is hoped that the work upon the cotton boll weevil may be continued with funds for its support equal to the amount appropriated for the fiscal year 1907, namely, \$85,000. It has been the experience of the Bureau in the investigation of this insect that at least two years must elapse after new territory is invaded before injury by the weevil reaches its height. Therefore it will not be possible to ascertain at all completely the effect that the radically changed conditions in Louisiana and Mississippi will produce upon the habits of the



weevil until the fiscal year 1908. During that year practically all of the work in Texas will probably have been completed, and further investigations in that State may be practically abandoned, the center of investigation being moved to the neighborhood of the Mississippi River.

With regard to the effort to prevent the further spread of the gipsy moth and the brown-tail moth, the sum appropriated by Congress for the fiscal year 1907 is only \$85,000, whereas \$150,000 was asked by the New England members of Congress supporting the movement. Even with the large sums expended by the State of Massachusetts, to which must be added the appropriations already made or to be made by the States of Connecticut, Rhode Island, New Hampshire, and Maine, and possibly also Vermont, the sum of \$85,000 is too small to effectively cover operations along the main-traveled roads leading out of the most thickly infested district, which, as has been elsewhere shown, is undoubtedly the most effective way of preventing the further spread of the moth. The large sums appropriated by the State of Massachusetts are, by an arrangement existing between the State authorities and the Bureau, to be devoted mainly to the clearing up of territory away from these roads, such as the woodland tracts, in accordance with the State law which provides for the compensation by the State to towns of a certain percentage of the amount expended under the direction of the State superintendent. Should, therefore, the appropriation of \$85,000 for the fiscal year 1907 be increased to \$150,000 for the fiscal year 1908, it is certain that more effective work can be done and the spread of the gipsy moth much more effectively checked. It is recommended, for reasons which appear earlier in this report, that the brown-tail moth be not included in this appropriation clause.

An enlargement of the work now being done in nearly all of the branches of investigation under way is most desirable, and will bring results of greatly added value.

In the work on insects injurious to field crops, the amount which the Bureau has been able to expend is very small compared with the enormous value of these crops. The desirability of a field station on the Pacific coast is obvious, in view of the great damage to grains done by insects in that region during the past summer. It is also desired to undertake careful investigation of insects injurious to the apple, to extend further the investigations regarding forest insects, to undertake some elaborate selective breeding experiments with bees, and to have more funds for the investigation of bee diseases. The investigation of the white fly will need more funds before it can be carried to a proper conclusion. The services of several experts are needed in this investigation, and large-scale experimental and demonstration remedial work should be supported. The investigation into the natural history of the Texas cattle tick, interrupted at the beginning of the fiscal year 1907, as explained in the body of this report, should be resumed during the fiscal year 1908, as upon the results obtained by this investigation must depend in a certain degree the efficacy of the work of the Bureau of Animal Industry, supported by a special appropriation from Congress for the fiscal year 1907. Work on insects affecting vegetable crops should be extended, as well as upon the insects affecting the health of man.

An immediate investigation of much importance should be undertaken during that year, and will require a considerable expenditure of money—that is to say, an investigation of the hydrocyanic acid gas treatment of trees. This method is successful against scale insects damaging the citrus fruit industry of California, and is extensively used in that State and may well be adapted to use in Florida. This fumigation is, however, more or less in an experimental stage at the present time; no thorough scientific investigation of the subject has yet been made, and the importance of the interest involved fully warrants it, the value of oranges alone shipped from southern California during the winter and spring of 1906 amounting to over \$30,000,000. Some of the points to be investigated are the life of the gas as to its effects upon scale insects at different periods, indicating the necessary time of exposure; the relative pressure of gas in light and heavy dosage, and the pressure where different proportions of water are used with a given amount of cyanide and acid; the different proportions as indicating the margin between efficiency against the insect and danger to the tree and fruit; the influence of external conditions, such as the hours of treatment, weather, temperature, moisture of the air and foliage, physical health of the tree, and many other points of similar character. This investigation has been urged upon the Bureau recently by county horticultural commissioners and representative bodies of horticulturists throughout southern California.

It is recommended, therefore, that, in addition to the emergency appropriation for the cotton boll weevil and the gipsy moth already recommended by amount, the sum of \$120,000 be appropriated for entomological investigations, an increase of \$45,000 over the sum appropriated for the fiscal year 1907. This increase is recommended, as indicated, for the normal increase of work already undertaken, and for the inauguration of new work, as also indicated.

In regard to salaries, I respectfully urge that one additional clerk of class 1 and one additional clerk of class 2 be allowed for, and that the salary of the chief clerk of the Bureau be raised from \$1,800 to \$2,000 per annum, the additional clerks being needed by the increase in the work and to allow deserved promotions, the increase in the salary of the chief clerk to be given for reasons indicated in the last report. I also respectfully urge that the Chief of the Bureau should receive \$3,500 per annum, so as to place him on a par with the chiefs of the Bureaus of Soils and Statistics, and the Forest Service, and with the Director of the Office of Experiment Stations. It will be noticed that during the fiscal year 1907 the Bureau of Entomology controls the expenditure of more money in its work than any of the other branches of the Department with the exception of the Weather Bureau, the Forest Service, and the Bureaus of Animal Industry and Plant Industry; but the salary of the chief is lower than that of any other bureau chief with one exception. This will make an addition to the salaries of \$3,050, a smaller increase by nearly \$2,000 than was asked for last year.

## REPORT OF THE ACTING CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF BIOLOGICAL SURVEY,  
*Washington, D. C., August 1, 1906.*

SIR: I have the honor to submit herewith a report of the work of the Biological Survey for the fiscal year ended June 30, 1906, with outline of work for 1907, and recommendations for 1908.

Respectfully,

HENRY W. HENSHAW,  
*Acting Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The work of the Biological Survey is prosecuted along the lines laid down by Congress, as follows: (1) Investigations relating to the geographic distribution of animals and plants, including biological surveys and the determination of the life and crop belts; (2) investigations of the economic relations of birds and mammals to agriculture; (3) supervision of matters relating to game preservation and protection and the importation of foreign birds and animals.

The work of the Biological Survey began July 1, 1885. Its first investigations were in the field of economic ornithology, and were undertaken as a branch of the Division of Entomology. The following year the Survey was established as the Division of Economic Ornithology and Mammalogy. After twenty years' service as a Division, on July 1, 1905, by act of Congress, the Biological Survey was made a bureau. While this change of status brought no radical change in the character of the work of the Survey, it made possible a more efficient organization. This was effected under three heads:

(1) Geographic Distribution, in charge of Vernon Bailey. The office of Geographic Distribution has charge of field and office work relating to the collection, preparation, and elaboration of specimens and information illustrating the status and geographic distribution of North American animals and plants. It is engaged also in mapping the ranges of mammals, birds, reptiles, and plants, and the preparation of reports thereon. (2) Economic ornithology and mammalogy, in charge of A. K. Fisher. The office of Economic Investigations has charge of field and laboratory work relating to the food habits of mammals and birds, and of the collection of seeds and insects and other objects belonging thereto; also of the preparation of reports on the economic relations and food habits of birds and mammals. (3) Game preservation and protection, in charge of T. S. Palmer. The



office of Game Protection has charge of matters relating to the preservation, protection, and introduction of game and other animals, and of matters coming under the jurisdiction of the Department by reason of the Lacey Act.

The administrative assistant, H. W. Henshaw, has charge of the correspondence, business, and business office of the Biological Survey, including the photographic laboratory, and of all editorial and clerical work. In the absence of the Chief, the administrative assistant is the Acting Chief, and has general supervisory authority over all the work of the Biological Survey.

#### GEOGRAPHIC DISTRIBUTION.

##### LIFE ZONES AND CROP ZONES.

Early in the history of the Survey it was recognized that a close relation existed between the natural live zones of the country and the crop zones, and much time and attention has since been given to the collection of data bearing upon the subject.

It is well known that the plants, birds, mammals, and reptiles of different regions differ widely, and that the transition from one natural geographic area to another is often abrupt. Naturally these changes, whether abrupt or gradual, are accompanied by corresponding variations in the availability of the areas for different crops. Careful study of these areas has demonstrated that they result from differences in climatic conditions, and that the country can be divided into well-marked life and crop zones in accordance therewith. Up to the present time maps have been published showing the life zones of North America as a whole, of the United States, and of Texas and parts of New Mexico and Arizona, and lists have been published of the crops best adapted for cultivation in each zone. The detailed work necessary for the preparation of zone maps of the several States is being carried on as rapidly as funds permit, with the end in view that each farmer wherever located shall have a practical guide to the fruits, forage crops, and general crops that can be most successfully grown on his own ranch.

Scientifically valuable as such maps are, they are even more important from an economic point of view, and those already published have been widely utilized by agricultural experiment stations and for general educational purposes.

During the year work has been continued in California and adjoining areas and in New Mexico, Colorado, Wyoming, and South Dakota.

CALIFORNIA.—Field work in California, physiographically the most diversified and complicated of the States, was continued during the early part of the year by the Chief of Bureau and three assistants, and will be continued during the coming season. A vast amount of material on the distribution of the mammals, birds, reptiles, and woody plants of the State has been already gathered and elaborated for the final report.

During previous years the Survey had done considerable work in the arid desert region of southern California and Arizona. In view of the extensive development by irrigation now in progress in this region it was considered important to secure further data and to carry the work southward over the adjoining desert region of Lower Cali-

formia. For this purpose, in the spring of 1905, E. W. Nelson and E. A. Goldman, field naturalists of the Survey, were sent to southern California, and, after work in that region, continued south and made a reconnaissance survey of the peninsula of Lower California.

**TEXAS.**—A report on the life and crop zones, mammals, and reptiles of Texas, by Vernon Bailey, illustrated by a zone map of the State and numerous special maps, was published during the year. Full notes on the habits and relations of various mammals to agriculture in Texas, where such species as the coyote and prairie dog do enormous damage to farmers and stock raisers, are a feature of this report. Unfortunately the edition was so small that it was soon exhausted. It is hoped that it will be possible to issue a second edition of sufficient size to at least supply the demand from residents of the State.

A report on the birds of Texas, by H. C. Oberholser, will be completed as early as practicable. It will contain all available information on the relation of birds to agricultural interests, which are so important in this great State, and will throw much light on the problems of distribution.

**NEW MEXICO.**—Field work in eastern New Mexico has been nearly completed by Vernon Bailey, and in western New Mexico has been carried on by Bailey, assisted by N. Hollister, and will be continued. The life zones have been mapped for the Zuñi, San Mateo, Datil, and Gallinas mountains, and intervening country. This completes the detailed zone map for more than half of the Territory.

**COLORADO.**—Field work in northern Colorado by Merritt Cary resulted in a detailed zone map of a broad belt from Denver and Boulder to the Grand and Yampa river valleys, over a complicated area of high mountains and parks, steep slopes, and deep, fertile valleys. From Colorado Mr. Cary made a trip into the Bad Lands of South Dakota in continuation of work already begun in that State.

**ALASKA.**—Field work in Alaska was suspended during the year, W. H. Osgood, in charge of this work, remaining in Washington in order to prepare his accumulated notes for publication and do other necessary office work.

**MACKENZIE BASIN.**—E. A. Preble has practically completed the reports on his extensive field work in the Mackenzie River region, and is engaged in mapping the distribution of the mammals, birds, and forest trees. The results are of the greatest importance in connection with the work of the Survey in Alaska.

**DISTRIBUTION OF DUCKS AND GEESE.**—The principal work of Prof. W. W. Cooke, temporary assistant in charge of bird migration, has been in connection with a report on the "Distribution and migration of North American ducks, geese, and swans." This has been completed and is now ready for publication. Another bulletin, on the "Distribution and migration of North American shore birds," is about half completed. This will serve as a basis for practical legislation in relation to shore birds as the other will to ducks.

**BIRD MIGRATION WORK.**—During the year the usual spring and fall migration schedules have been sent to and received from field observers and filed for future use.

The work of copying, classifying, and making available the notes

contributed by migration observers has been continued and the work is now up to date. While the number of migration observers has not increased largely of late, there has been a noticeable and welcome improvement in the character of the reports, and the Survey is rapidly accumulating a series of accurate observations from single localities which will serve as a basis for valuable conclusions regarding the phenomena of migration in the United States.

IDENTIFICATION OF BIRDS AND MAMMALS.—In addition to the regular work of this branch of the Survey the task of identifying specimens of birds and mammals for colleges and museums throughout the country has grown until it occupies much time. This work, however, yields much valuable data on distribution, and thus is of distinct advantage to the Survey.

#### ECONOMIC ORNITHOLOGY AND MAMMALOLOGY.

The increasing importance of all branches of agriculture in the United States and the value of the products of the soil are being augmented from year to year by leaps and bounds. Irrigation is making available to the farmer and orchardist many thousand acres of land hitherto of little or no value, and a systematic search is being conducted in foreign countries for useful plants suitable for transplanting to American soil, with the result that many valuable varieties have already been introduced. Along with new fruit and forage plants new insect pests are continually finding their way into the United States, either by extension of range from contiguous regions or by means of commerce. As large tracts of heretofore wild land are brought under cultivation, the rodents that inhabit them become troublesome factors, more particularly as the abundance of new food in the shape of cultivated cereals enables them to multiply much more rapidly than was possible when dependent upon the more scanty larder of unassisted nature. As a result of the changed conditions, invasions of new insect pests and inroads of noxious mammals are frequent and often disastrous.

As the acreage under cultivation is extended and as the number of destructive insects increases, more and more importance attaches to the study of the economic status of birds. A knowledge of the species which can be relied upon to aid the farmer in his constant warfare against pests is necessary as a basis for legislation for the protection of the friendly species; and the discovery of preventive methods against injurious species is equally essential.

The study of our common mammals also is important. Some of these, formerly classed as noxious, are now found to be beneficial, because their food has been ascertained to consist largely of insects. Others, especially certain rodents, are known to be directly injurious, and as larger crops are raised and the animals multiply with the added food supply, the amount of damage is correspondingly great, hence the necessity for the discovery and utilization of more effective and cheaper methods of controlling these pests.

PREVENTIVE MEASURES AGAINST MAMMALS.—Experiments with poisons to destroy coyotes, rabbits, rats, and mice have been in progress during the year and will be continued. Experiments with fences to protect sheep from coyotes are now in progress, in cooperation with



flock owners in the West, and others have been planned, but have been delayed for lack of funds. These, as well as experiments with fences to protect nurseries and certain garden crops from rabbits, will be continued during the coming year.

In connection with the depredations of rabbits, experiments with a view to the protection of newly planted trees have been undertaken in cooperation with the Forest Service. An attempt is being made by the Forest Service to reforest upward of a hundred thousand acres of the San Gabriel Forest Reserve in southern California. This tract abounds in small rabbits, and in places these rodents have destroyed as high as 30 per cent of the seedlings, thus necessitating repeated and costly replantings. As attempts to destroy the animals by ordinary means have proved both expensive and inadequate, the Forest Service has requested the cooperation of the Biological Survey. A method has been devised of protecting the seedlings by cheap wire screens, and these in connection with practical methods of poisoning will, it is believed, go far to solve the problem.

**WOLVES.**—Gray wolves are still numerous in the West and in certain sections are so abundant that they cause much loss to ranchmen and farmers. Their large size and strength make them formidable enemies of calves and colts and even of full-grown animals. The problem of ridding the forest reserves and cattle range of gray wolves was taken up by the Biological Survey at the request of and in cooperation with the Forest Service. An experienced field naturalist was detailed for the work and visited parts of Wyoming and New Mexico for the purpose of determining the extent of the losses in live stock and game, and of studying the methods most effective in destroying wolves. A preliminary bulletin on the subject has been prepared by this assistant, and is to be published by the Forest Service for distribution to forest rangers, ranchmen, hunters, and trappers in the wolf-infested regions.

The protection of stock on the western ranges and of wild game in the forest and game preserves from the depredations of wolves, coyotes, panthers, and other carnivorous animals is of such growing importance that it is intended, if funds are available, to employ assistants acquainted with the habits of these animals to visit the several reserves and contiguous stock ranges for the purpose of devising methods for the destruction of the animals.

**BACTERIAL DISEASES.**—A comparatively new field of research in our country is the study of diseases of a bacterial character, cultures of which may be preserved indefinitely, for the purpose of destroying noxious animals.

It has been known for a long time that many, if not all, of the small rodents that live in colonies or exist in great numbers within limited areas are subject from time to time to epidemic diseases which so decimate their numbers as to practically eliminate them as disturbing factors of agriculture till they have had time to again increase abnormally.

It was not until recent years, during which the study of bacterial diseases received great impetus, that the nature of such epidemics and the possibility of isolating, propagating, and utilizing the bacilli for destroying noxious mammals has been appreciated. Such diseases appear often to be limited to particular species or to a group of closely related species, and hence are harmless to man and to domestic ani-

mals. Only, however, after careful experiments to determine their nature and limitations can the employment of such diseases for the purpose suggested be recommended.

For several years studies of bacterial diseases have been carried on in European countries for the purpose of discovering a virus which could be used as an effective ally in warring on rodent pests. Several such cultures have recently been placed on the market, and the Biological Survey is now engaged, in cooperation with the Bureau of Animal Industry, in testing the efficacy of one of these—for which much is claimed in Europe—for the purpose of employing it against certain American mammals, especially rats and field mice.

Of vastly more importance, however, are investigations recently begun by the Survey to ascertain the causes, nature, and effects of local diseases known to occur at irregular periods among American rabbits, prairie dogs, ground squirrels, and other rodents.

Among the most troublesome of these animals are the ground squirrels, several species of which are very destructive to crops in many parts of the West, notably in Washington, Oregon, Idaho, and California. In eastern Washington two species (*Citellus columbianus* and *C. townsendi*) do enormous damage, the annual loss from these rodents and the expenses of repressive methods in a single county reaching upwards of half a million dollars.

The bacillus of a disease fatal to one of the above species was discovered some years ago by Prof. C. V. Piper and Dr. S. B. Nelson, then connected with the experiment station at Pullman, Wash. Cultures were made in the laboratory and experiments were conducted with a view to the utilization of the virus in destroying the animals in the wheat fields, but the work was not completed owing to lack of the necessary funds. The work has been taken up by the Biological Survey in cooperation with the State experiment station at Pullman, and experiments are now being conducted with every promise of successful results. It is hoped eventually to secure a virus which can be utilized on a large scale to destroy the rodents which now levy so severe a tax on the wheat crops of the Northwest.

Confidence is felt that the discovery and isolation of the bacilli responsible for fatal diseases in the case of rabbits, prairie dogs, field mice, and other noxious rodents is entirely practicable, and it is hoped that funds for the necessary investigations will be made available. By a comparatively small outlay it is thought that methods can be devised to introduce fatal diseases among noxious mammals by means of which their numbers can be so reduced as to render them practically harmless to farming interests.

In connection with these investigations a circular has been prepared and distributed to experiment stations and farmers and stockmen in the western States for the purpose of eliciting information as to the presence of epidemic diseases among rodent mammals. It is hoped by this means to secure information in time to obtain cultures for preservation and future use.

COOPERATIVE WORK.—For the prosecution of the laboratory work necessary in connection with these experiments the cooperation of the Bureau of Animal Industry has been obtained. Doctor Melvin has kindly consented to aid the Survey to the utmost extent possible, and at his instance Dr. Marion Dorset, in charge of the Biochemic Division,

has conducted laboratory experiments with a commercial virus imported from France with a view to ascertaining its efficacy in destroying certain small American mammals. He has undertaken, also, to preserve in the laboratory cultures of the bacillus, now being experimented with on ground squirrels in Washington, so that its preservation for immediate use is assured.

The importance of the work above outlined and the necessity for extensive field experiments conducted over a term of years renders cooperation with State experiment stations particularly desirable. Arrangements have been made with the Washington Experiment Station, as stated above, to conduct cooperative experiments on ground squirrels, or spermophiles, and it is hoped that as the work progresses similar arrangements can be made with stations in other States where the damage from various mammals presents a very serious problem.

**EXAMINATION OF BIRD STOMACHS.**—As in previous years, field and laboratory work on the food habits of birds has been carried on simultaneously. A large number of stomachs was received during the past year from various parts of the United States, and the analysis and tabulation of their contents far exceeded the capacity of the small force engaged in the work. It is hoped that an increase of funds during the coming year will enable additional assistants to be employed, when the work will be pushed as vigorously as its importance demands.

Professor Beal, chief assistant in this branch of the work, spent several months of the present year, and will occupy a considerable part of the coming season, in studying the food habits of birds in the fruit districts of California and Oregon with a view to discovering means of altogether preventing or greatly restricting the damage to the olive, grape, cherry, and other fruit crops of these States. A preliminary report upon the damage by birds in the garden and orchards of California by Professor Beal, with suggestions for remedial measures, has been completed and will be published during the coming year.

**GEESE.**—From time immemorial California has been a favorite resort for waterfowl, and many thousands of geese of several species annually winter within the State. As the grassy plains, where they formerly fed, were converted into wheat fields the birds transferred their attention from the succulent grasses to the more nutritious cereals. So destructive are the geese in certain sections that the problem of protecting the grain from their ravages is a serious one and necessitates large outlay.

The simplest and most direct method of protection is the destruction of the geese by means of the rifle and shotgun. This plan requires the services of several men on each ranch, and is not only expensive, but objectionable, in so far as it necessitates the slaughter of valuable food birds with practically no return other than the protection of grain. Wild fowl are a valuable asset, both as an article of food and as a source of revenue from sportsmen; hence they should be protected when their protection is not incompatible with more important interests.

The preservation of geese in California is the more important, as this State is one of the birds' last strongholds. In the Eastern States geese are becoming fewer and fewer each year, and their practical extinction there can not be far distant.



During the present year Doctor Fisher visited California in connection with this problem, and will continue investigation during the present season with a view to the discovery of methods of protecting the grain fields without unnecessary destruction of the geese.

**COTTON-BOLL WEEVIL.**—Investigations of the relations of birds to the cotton-boll weevil was continued during the past year. Field work in connection with the problem was conducted in Texas during the greater part of 1905, and about 2,000 birds' stomachs were examined for the purpose of ascertaining what species are most serviceable in destroying this pest. One hundred and eight individuals of 12 species were found to have eaten the weevil. Of these, orioles proved to be the greatest destroyers of the pest, as many as 41 weevils having been found in the stomach of a single oriole. The nighthawk also was discovered to be an enemy of the weevil, and further investigations will probably prove that during certain times of year these birds perform extremely valuable service in destroying the pest, and hence should be carefully protected. The list of birds ascertained to feed on the weevil now numbers 28. A bulletin in the nature of a report of progress on this work, by A. H. Howell, has just been issued.

**NORTH AMERICAN EAGLES.**—A report upon the North American eagles and their economic relations has been completed by H. C. Oberholser and will shortly be published. In it the food habits of these birds are given in detail, and their economic status is fully discussed with a view to determining the extent of protection, if any, that should be afforded them. They are found to be beneficial in some regions and their protection there is recommended. In other regions they are found to be injurious and protection may safely be withheld.

**FOOD OF WILD DUCKS.**—The food of wild ducks in its relation to their migration and the establishment of a proper open season continues a subject of investigation. Difficulty is experienced in obtaining a sufficient number of stomachs of these birds, especially from unrepresented territory, for definite determination of their food, and final results are likely to be delayed for this reason. So far 520 stomachs have been examined.

**GROSBEAKS.**—The work on the economic relations of the grosbeaks is being continued and is nearing completion. A bulletin on this important group of birds—noted for feeding on the Colorado potato beetle and on scale insects—will probably be issued during the present year.

**MEANS OF ATTRACTING BIRDS.**—An important phase of bird increase and protection is the planting of berry-bearing trees and shrubs about the home and orchard. An increased food supply naturally tends to an increased number of birds, and the planting about orchards and gardens of berry-bearing shrubs—important as bird food, but worthless to man—makes directly for the protection of valuable fruit. There are many such trees and shrubs, the fruit of which is preferred by our native birds to the larger cultivated kinds which derive added value from their ornamental character. This subject is receiving constant attention and a bulletin will be forthcoming at an early day.

During the year 5,638 bird stomachs were received and 2,236 were examined and their contents tabulated.

## GAME PROTECTION.

Acting under the provisions of law requiring the Secretary to collect and publish useful information in regard to game birds and to adopt such measures as may be necessary to carry out the provisions of the Lacey Act, the office of Game Protection endeavors to keep in touch with all efforts to protect or propagate game in the United States and to a certain extent in other countries. To this end constant communication is maintained with game officials, State and private organizations, directors of zoological parks, and private individuals in this country and abroad. Aid is given to measures for the preservation of game, and attempts are made to promote cooperation between the authorities of the several States and also between these and the Department. Its efforts are divided between this educational work and the purely administrative duties assigned it, such as (1) supervision of the importation of foreign wild animals and birds; (2) cooperation in the enforcement of provisions of the law governing interstate commerce in game and educational work, such as securing, filing, and publishing information concerning important subjects in game-protection matters; (3) administration of the Federal bird reservations, and (4) the protection of game in Alaska.

## IMPORTATION OF FOREIGN MAMMALS AND BIRDS.

During the year 433 permits were issued for the entry of foreign wild mammals and birds and 5 for the entry of eggs for propagation. Under these permits 654 mammals, 274,914 canaries, 47,383 miscellaneous birds, and 5,564 pheasant eggs were brought into the United States. In addition to these, there were imported 1,636 mammals, 2,696 canaries, and 11,040 miscellaneous birds, for which no permit was necessary.<sup>a</sup> The number of entries was larger than in any previous year, in spite of the fact that no importations were received at San Francisco subsequent to April 18, 1906, the date of the earthquake. Last year 390 permits were issued, under which were imported 178 mammals, 230,682 canaries, 27,957 miscellaneous birds, and 2,270 eggs.

The total number of species of birds represented in the year's importations was 344. A few of these were game birds for stocking covers, but by far the larger part consisted of birds for confinement as pets, specimens for exhibition, and public zoological collections.

The law prohibiting the entry of certain birds and mammals likely to prove serious pests is becoming more generally known, and during the year no noxious species were offered for entry, nor did strict surveillance disclose any attempt to introduce them surreptitiously. One of the few known specimens of mongoose in captivity in the United States, that in the National Zoological Park, died on June 2, 1906.

**PHEASANTS.**—The importation of pheasants for zoological parks and private aviaries included 15 Cabot, 10 Temminck, and 2 horned tragopans, 8 monaul or impeyan pheasants, 2 black-backed kaleeges, 8 Siamese pheasants, 2 of the rare Hoki pheasants, and 1 rufous-tailed pheasant (*Gennæus erythrophthalmus*), apparently the first of this species brought into the country.

<sup>a</sup> Exclusive of packages of mammals and birds, chiefly monkeys, parrots, and pigeons, the exact number of individuals in which was not stated.

MISCELLANEOUS CAGE BIRDS AND MAMMALS.—Among the interesting importations for exhibitions and private collections were 11 beaver from Canada; 2 echidnas from Australia; 2 black-footed penguins from Australia; 4 painted quail from China; 2 green-billed toucans from Guiana; 3 cayenne rails from Brazil; 2 Madagascar porphyrios (gallinules); 1 ostrich from Somaliland; 4 keas, 4 weka rails, and 4 kiwis, flightless birds from New Zealand; 10 of the rare rosy-billed ducks from South America; 11 African edelsingers; and 10 masked waxbills from Africa. It is interesting to note an increase in the importation of the attractive shama thrushes from India, of which 58 were imported during the year.

EGGS.—The poor success attending previous efforts to import the eggs of game birds for hatching in this country seems to have exercised a discouraging influence, and few such importations were made. The most important was the entry of 5,500 pheasant eggs from Liverpool, England, about the 1st of June, 1906, by the game commissioner of Illinois. Of this shipment only 8 eggs were broken in transit and 10 more in unpacking. One thousand eight hundred and nine eggs were infertile, and further losses were incurred from various other causes, but from the 5,500 eggs 3,000 live, healthy chicks were secured. It remains to be seen what percentage of these attain maturity.

INSPECTION.—For several years much dissatisfaction has been shown by importers with the payment of fees and with other details of the inspection service. This feeling culminated in an appeal to the Board of Appraisers at New York late in 1905. The appeal was dismissed by the Board for lack of jurisdiction, but the Department has since removed the cause of complaint by placing the inspection service upon a more satisfactory basis. On February 1, 1906, it temporarily assumed the payment of fees and established an office in New York City, from which an inspector may always be obtained at short notice. With the service as now reorganized, the Department has eleven inspectors, distributed as follows: Two each at Boston, New York, San Francisco, and Baltimore, and one each at Philadelphia, New Orleans, and Honolulu. In the absence of a specific appropriation for inspection service it is possible to examine only the most important shipments, the great majority of which are entered at New York and Philadelphia. It is highly desirable that inspections should be made at San Francisco, and to a limited extent at Boston and New Orleans, and that more of the shipments at New York and Philadelphia should be examined. Under the fee system the entire service could be put on a substantial basis at a cost not to exceed \$1,000 per annum. The necessity for this check on the introduction of noxious birds and animals is amply demonstrated by the experience of other countries, where the mongoose and other injurious species have gained a foothold. The incalculable injury done by these pests and the constant danger of their intentional or unintentional importation into the United States makes the expense of a rigid inspection service insignificant in comparison with the losses which are sure to follow ill-advised and unchecked importation. The introduction and spread of the English sparrow shows the importance of taking every precaution against the entry of other pests which might prove even more destructive.



GAME BIRDS FOR PROPAGATION.—As the supply of native game birds diminishes, the importation of birds from foreign countries for stocking covers assumes greater importance. Among the importations of the year were 864 European partridges, chiefly for stocking private preserves, and 81 capercaillie, 50 black game, 30 willow grouse, and 15 hazel grouse for liberation on Grand Island, Mich. The Massachusetts game commission imported 8 capercaillie and 12 black game for liberation, and 27 capercaillie and 11 black game were brought in for various other destinations, chiefly private preserves. Fourteen bamboo partridges were imported from China for the State of Washington last July and from recent reports seem to be doing well.

The depletion of quail covers by recent severe winters has resulted in vigorous efforts in various parts of the country to secure birds from sections where they still abound. The quail of Mexico were drawn on, and 148 bobwhite and 2,400 Mexican quail were imported and shipped to northern points. These proved unsatisfactory and native quail were sought to meet the demand. Owing, however, to the strict and comprehensive nonexport laws of most of the States, the supply of available birds has been far below the demand, and consequently the stock of quail in those States from which the birds could be legally secured has been recklessly diminished; in other States violations or evasions of the law have occurred. In Alabama a few shippers furnished eastern and northern States with enormous numbers of quail, which it is by no means certain will be able to withstand the climate of the regions where the birds were liberated. A similar attempt to meet the demand was made in Texas, where, however, the State law was violated, and the quail trappers were arrested and confined in jail.

Despite these strenuous efforts to supply the demand, and despite all attempts to meet the deficiency by proper and moderate transfer of domestic birds, the demand continued greatly in excess of the supply. If such depletion recurs, better methods will have to be devised to restore the normal abundance. To stock one part of the country at the expense of another without careful safeguards to prevent depletion of the covers drawn upon is mistaken policy. The supply should be taken from a number of points to avoid too great a drain on limited localities, and all trapping and export of birds for propagation should be under State control and not left to unchecked individual enterprise.

Before the demand for quail can be satisfied, means must be devised whereby the birds can be propagated profitably on a commercial scale. It is estimated that during the past year Alabama furnished about 100,000 quail, and the West and Southwest 50,000 more. Prices ranged from \$4 to \$5 per dozen for southern birds, and \$10 a dozen for those from the Southwest. Thus, all told, \$75,000 to \$100,000 worth of quail were required for a partial supply of the existing demand. Severe winters are likely to recur, and even under favorable climatic conditions, excessive hunting and the rapidly increasing number of game preserves will create a constant demand for birds for propagation. Already quail have been raised in confinement in an experimental way, but with varying success. All the difficulties have not yet been overcome, but they are not insuperable, and it is to be hoped that State or private enterprise may successfully meet them at no distant date.

HAWAII.—Thirteen permits were issued for the entry of 9 mammals, 15 birds, and 1 lizard at Honolulu during the year, imported chiefly from Australia, China, and Japan. In June, 1905, a consignment of rattlesnakes was received from San Francisco. These snakes were designed for public exhibition in a small zoological collection. They were promptly destroyed by the inspector at Honolulu, and, in reponse to strong public sentiment, former restrictions on entries into Hawaii were extended to cover all snakes, instead of poisonous ones alone.

#### INTERSTATE COMMERCE IN GAME.

Seven cases of violation of the interstate-commerce provisions of the Lacey Act have been reported to the Department during the year and six are still pending. Two of these cases involved the illegal shipment of 133 ducks and 1 grouse from North Dakota; one, shipment of 6 prairie chickens from South Dakota; and two, shipment of 313 quail from Oklahoma. The other two cases originated in West Virginia. One of them related to unlawful transportation of quail by a mail carrier on the route from Capon Bridge, W. Va., to Winchester, Va., and upon a report of the facts to the Postmaster-General an investigation was made, which resulted in doing away with the traffic. The other was based on the seizure of a shipment of ruffed grouse en route to Baltimore.

Convictions were secured in two cases on indictments filed in previous years, one involving the shipment of quail from Oklahoma and the other prairie chickens from Vilas, S. Dak.

Conditions in the Middle West, where violations of this character have been most frequent, have undergone marked change during the past year. Consignments at Chicago and St. Louis have greatly decreased in number, and shippers are now resorting to means other than the express to reach the market. The steady restrictions of sale and shipment, and the consequent diminution of profit have reduced the importance of these shipments, and attention is now directed mainly to the problem of discovering and dealing with the novel methods of evading the law practiced in the Southwest. In some of the Eastern States and in the South illegalities also require special consideration. Reports are frequently received of shipments of quail, ruffed grouse, and other game to the markets of Washington, Baltimore, and Philadelphia from points in Virginia and adjoining States in violation of the Federal law, but efforts to prevent such shipments thus far have not been successful.

#### BIRD RESERVATIONS.

Four new bird reservations have been established by Executive order during the year, namely, Huron, Siskiwi, and Passage Key Reservations in the fall of 1905 and Indian Key Reservation early in 1906.

The table on page 409 presents a convenient summary of the seven reservations thus far established.

*Bird reservations established to June 30, 1906.*

Reservation.	Location.	Area (approximate).	Date of order.
Pelican Island .....	Indian River, Florida .....	5 acres .....	Mar. 14, 1903
Breton Island .....	Group of 3 islands in Gulf of Mexico, off coast of Louisiana.	Unknown .....	Oct. 4, 1904
Stump Lake .....	4 islands, Nelson County, N. Dak .....	28 acres .....	Mar. 9, 1905
Huron Islands .....	5 islands off south shore of Lake Superior, Michigan.	Unknown .....	Oct. 10, 1905
Siskiwit Islands .....	South of Isle Royale, Lake Superior, Michigan.	.....do .....	.....do .....
Passage Key .....	Mouth of Tampa Bay, Florida .....	36 acres .....	.....do .....
Indian Key .....	.....do .....	Unknown .....	Feb. 10, 1906

These islands are small, low, swampy, or rocky and of no value for agricultural purposes. They are the breeding or winter resorts of large colonies of useful or interesting birds, and in setting them aside as reservations the United States is carrying out a policy which has been adopted in Australia, New Zealand, Canada, the British Colonies in Africa, and other parts of the world. Warden service is maintained on these islands in cooperation with the National Association of Audubon Societies, and the good results are already apparent. The only known breeding colony of brown pelicans on the east coast of Florida now has assured protection and is showing a gratifying increase, and the establishment of Breton Island reservation has preserved thousands of wild ducks from slaughter.

**PELICAN ISLAND RESERVATION.**—Nesting was begun early in November, 600 nests having been constructed by November 18. By the end of the year many young were hatched and the colony seemed in a prosperous condition, but about the middle of February the young began to die and in a few days 600 or 700 of them perished. Unfortunately a request to the warden to forward some of the birds for examination was received too late. Prof. William L. Underwood, of the Massachusetts Institute of Technology, who was present on the island, dissected one of the dead birds. He found no evidence of disease, and it is probable that the mortality was due to cold and exposure to inclement weather. About 150 young survived and by the 1st of April were able to fly. On April 15 the old birds began to nest again, and by May 5 the second broods began to hatch. Two hundred nests were occupied and about 400 young raised in this second nesting.

**BRETON ISLAND RESERVATION.**—The ducks wintering on this reservation were protected from attacks of market hunters, and the royal, Wilson, and Cabot terns successfully bred on some of the islands in the summers of 1905 and 1906. The president of the Audubon Society of Louisiana reports that while on a tour of inspection in June, 1906, he found that on this reservation and the Audubon reservation, maintained on the adjoining coast by the Louisiana Audubon Society, fully 100,000 terns were reared during the present season.

**STUMP LAKE RESERVATION.**—The value of setting aside certain tracts where absolute protection is accorded to bird life has been emphasized by the fact that Stump Lake Reservation not only affords protection to the birds that nest there, but during the open season has proved a haven of refuge to birds driven from their usual resorts in the vicinity.



**HURON ISLANDS RESERVATION.**—Five small unsurveyed islands, situated in Lake Superior, 4 miles from the south shore, are occupied as a breeding place by about 700 gulls and a few mergansers. From 1,200 to 1,500 young gulls and a few mergansers were hatched in the summer of 1905.

**SISKIWIIT ISLANDS RESERVATION.**—All of the unsurveyed islands lying near the mouth of Siskiwit Bay on the south side of Isle Royale in Lake Superior compose the Siskiwit Islands Reservation, which, like the Hudson Islands Reservation, is a breeding place for gulls. These two reservations contain the most extensive breeding colonies of herring gulls in the interior.

**PASSAGE KEY RESERVATION.**—Passage Key Reservation comprises an island near the mouth of Tampa Bay, and is frequented by large numbers of terns, ducks, cormorants, brown pelicans, and other birds. Among the birds present in January were some 3,000 Florida cormorants, 5,000 red-breasted mergansers, 3,000 royal terns, and 1,000 tree swallows. Among the May birds, many of which were probably nesting, were approximately 5,000 Louisiana herons, 8,000 terns of various kinds, and 100 brown pelicans.

**INDIAN KEY RESERVATION.**—Indian Key Reservation is situated in Tampa Bay, about 5 miles northeast of Passage Key. It is a breeding place and winter resort for herons, cormorants, terns, and other sea birds.

**PROTECTION FROM TRESPASS.**—Occasional difficulty has been experienced in protecting some of these reservations from trespass, but Congress has recently passed an act (approved June 29, 1906) making it a misdemeanor to hunt or trap birds on bird reservations, willfully disturb them, or take their eggs. This act will materially aid the Department in preventing such depredations.

#### BIG GAME REFUGES.

The transfer to the Sequoia National Park of part of the herd of dwarf elk, presented to the Government by Miller & Lux some years ago, was successfully accomplished in November, 1905. About 20 of the animals were captured on the Button Willow ranch; transferred by rail to the station nearest the park, and placed in the inclosure constructed for them in 1904. The elk now in the park form the nucleus of a new herd which, with adequate protection and the favorable surroundings afforded by the park, it is hoped may insure the preservation of this fine species.

The New York Zoological Society generously offered 15 or 20 buffalo to the Department on condition that a suitable range be inclosed for them on the Wichita Game Preserve in Oklahoma. This new preserve, situated in the midst of the former natural range of the buffalo, affords an ideal location for the establishment of a herd under Government auspices, but it was impossible to accept this offer at once on account of lack of an appropriation for fencing the proposed range. The matter was presented to Congress and an item was included in the current appropriation bill providing \$15,000 for the construction of the necessary fence under the supervision of the Forest Service.

## PROTECTION OF GAME IN ALASKA.

Conditions under the Alaska game law remain practically unchanged, and the close supervision of exports and the restricted issue of permits have been continued. Special restriction of the export of trophies from the Kenai Peninsula has been maintained for several seasons on account of the danger threatening the game because of the accessibility of the region and its peculiar attractiveness to sportsmen in search of big game. During the past year the issue of permits was confined mainly to the open season, and early in the spring was temporarily suspended. Comparatively few permits were granted, chiefly to residents of Alaska desiring to bring home a few heads for their own use.

The question of the shipment of trophies has proved the most troublesome feature of the law and has given rise to considerable dissatisfaction. The question is complicated by the occurrence on the Kenai Peninsula of the largest species of moose in the world, the heads of which are greatly sought as trophies. Horns having a spread of 72 inches or more command fabulous prices, which makes head hunting one of the chief objects both of sportsmen and natives. Every device is employed to obtain permits to bring out moose heads, and no means of checking this traffic have been devised, except the unsatisfactory expedient of prohibiting all shipments from the Kenai Peninsula.

The permits issued may be divided into three groups—those for shipment of trophies, those for collecting specimens for scientific purposes, and those for capture of live game intended for propagation or exhibition. According to the records of this office 204 permits have been issued since the passage of the law in 1902, as shown in the following table:

*Number of permits issued for the shipment of trophies and specimens from Alaska.*

Year ending June 30—	Trophies.	Scientific specimens.	Propagation.	Not used or canceled.	Total.
1903.....	34	12	2	13	<sup>a</sup> 61
1904.....	43	8	0	16	67
1905.....	12	4	3	9	28
1906.....	23	8	1	16	<sup>b</sup> 48
Total.....	112	32	6	54	204

<sup>a</sup>Two duplicate numbers.

<sup>b</sup>One duplicate number.

The total number of permits for export of trophies was 112 and for export of scientific specimens 32, or an average of 28 and 8, respectively. The number issued during the past fiscal year was 23 for trophies, 8 for scientific specimens, and 1 for live birds (for the New York Zoological Park). These figures, however, are greatly in excess of the number of permits actually used. The Department has direct knowledge that 54, or more than 25 per cent of the total number issued, were canceled or remain unused, and as the reports of the collector of customs at Seattle, where most of the Alaska shipments are received, show the receipt during the entire four years of only 47 consignments (35 of trophies and 12 of specimens), it is evident that many permits remain unused of which no direct information has been

received. In the past year, with 32 permits outstanding, the number of consignments received at Seattle was only 10, of which 4 were heads forwarded for mounting to be returned to Alaska and 1 was a head in transit from British Columbia. It is evident, therefore, that in spite of the frequent demand for permits and the great pressure brought to bear on the Department in order to secure them, comparatively few are actually used.

To relieve the Department of much unnecessary criticism a transfer of the issue of permits to some convenient point in the Territory where, when necessary, conditions can be readily investigated, seems desirable. It is hoped that this matter will be considered by the next Congress, and that the present law will be modified.

#### INFORMATION CONCERNING GAME.

Many requests are received for information concerning game and game protection. Among the most important was one in connection with an effort to maintain the law prohibiting the sale of imported game in close season in the State of New York. Such sales have already been practically stopped in the District of Columbia, and in Minnesota, New York, Ohio, Wisconsin, and other States. The question was taken up with State officers in California, Colorado, Illinois, Indiana, Minnesota, Nebraska, New Jersey, and Ohio, and data were obtained which proved of material assistance in connection with the measure under consideration.

In response to a request received from the Massachusetts State Game Association, similar information was furnished concerning the sale of game from the West in the markets of Boston. The necessity was clearly shown of restricting the sale of such game in Massachusetts to the open season, in order to prevent evasion and violation of the Federal law and the laws of the States from which the shipments were made.

Wisconsin has recently passed a law placing deputy game wardens under the civil service and requiring applicants for the position to take competitive examinations. In the adoption of this important step in the administration of the local law the State warden asked for suggestions from the Department, which, in response to the request, recommended certain subjects and conditions which might advantageously be incorporated in such examinations. Requests are frequently received from game officials and associations for information, personal conference, or representation at meetings. Such requests are complied with whenever possible, and during the year personal consultations were had with State officials of California, Idaho, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Jersey, New York, North Carolina, Ohio, Tennessee, Virginia, West Virginia, Wisconsin, and Wyoming. Many of these were held at the meeting of the National Association of Game Wardens at St. Paul, in January, 1906, which afforded an opportunity for conference with a number of State officers of the Northwest.

Considerable progress has been made during the year on the index of game laws and the bibliography of game literature mentioned in the last report. A complete index of the laws of Missouri and California, covering more than half a century, was added to the work already done in indexing State laws; and several of the more important



serials, together with some of the current foreign game laws, have been examined for material for the bibliography. The index of decisions on game laws, which was undertaken at the request of the National Association of Game Wardens, has been nearly completed. The plan of the work was submitted to the association at the annual meeting in January, 1906, and received the approval of the committee appointed to examine it. As soon as additions suggested by the committee have been incorporated, the index will be prepared for publication.

Owing to greatly increased interest in the game-refuge idea and because of pending legislation on the subject by Congress, it was deemed desirable to investigate methods of establishing and maintaining game refuges in other countries. Data have been collected respecting the game refuges of Canada; of Denmark and Norway in Europe; of British East Africa, Cape Colony, Natal, Sudan, and the Transvaal in Africa; and some of the States of Australia. Information has been secured also concerning methods of preserving moose or elk practiced in Sweden for the past one hundred and fifty years.

The usual summary of State game laws affecting seasons, shipment, and sale was issued, as well as posters showing close seasons for game in the United States and Canada. As many of the close seasons in North Carolina were changed by a revisal of the laws of that State, which was published too late to be incorporated in either bulletin or poster, a special poster was issued showing the close seasons of North Carolina as modified by the revisal.

While, as stated, information and assistance have been promptly furnished whenever possible in response to the numerous demands made on the office, on the other hand, it is a pleasure to state that ready and hearty cooperation has been met with from game officials and organizations of the United States and other countries, railroad and express companies, and many private individuals.

#### ROUTINE WORK.

As the field work of the Survey increases and new lines of investigation are undertaken, the amount of routine work increases correspondingly. This consists of correspondence, chiefly in the nature of responses to requests for information, preparing reports and bulletins for publication, identifying and labeling specimens, storage and care of field collections, cataloguing bird stomachs, tabulating field reports, sorting and filing published matter valuable for reference, mapping distribution of birds and mammals, supplying the needs of field assistants, developing photographic plates and making prints therefrom, compiling game laws, issuing permits for the entry of foreign mammals and birds and for the export of trophies and specimens from Alaska, and cooperation in enforcing the various provisions of the act of Congress of May 25, 1900. The letters received during the year numbered about 4,600, the letters written during the same period numbered about 6,500, and over 700 migration schedules were sent out to observers.

The collection of negatives made in the field for the purposes of study, record, and illustration now numbers about 10,000.

#### PUBLICATIONS.

The publications for the year include 1 number of *North American Fauna*, 4 bulletins, 5 circulars, 2 articles in the *Yearbook*, 1 *Farmers'*

Bulletin, the Report of the Chief for 1905, and 11 reprints of former publications.

North American Fauna No. 25, by Vernon Bailey, comprises a "Biological Survey of Texas." The Bulletins are entitled: No. 21, "The Bobwhite and Other Quails of the United States in their Economic Relations," by Sylvester D. Judd; No. 22, "Birds Known to Eat the Boll Weevil," by Vernon Bailey; No. 23, "The Horned Larks and their Relation to Agriculture," by W. L. McAtee; No. 24, "The Grouse and Wild Turkeys of the United States and their Economic Value," by Sylvester D. Judd; No. 25, "Birds that eat the Cotton Boll Weevil," by Arthur H. Howell. The Farmers' Bulletin is "Game Laws for 1905; A Summary of the Provisions Relating to Seasons, Shipments, Sale, and Licenses," by T. S. Palmer, Henry Oldys, and R. W. Williams, jr. (No. 230). The articles in the Yearbook are entitled, "Federal Game Protection—a Five Years' Retrospect," by T. S. Palmer; and "Meadow Mice in Relation to Agriculture and Horticulture," by D. E. Lantz. The titles of the circulars are as follows: No. 49, "Directions for Preparing Specimens of Large Mammals in the Field," by C. Hart Merriam; No. 50, "Directory of State Officials and Organizations Concerned with the Protection of Birds and Game," by T. S. Palmer; No. 51, "List of Publications;" No. 52, "Directions for Destroying Pocket Gophers," by D. E. Lantz. In addition, reprints of the following were issued: Bulletin, 1; Farmers' Bulletins, 3; Yearbook articles, 3; circulars, 4.

## OUTLINE OF WORK FOR 1907.

### GEOGRAPHIC DISTRIBUTION.

Field work in California, New Mexico, Colorado, and South Dakota, to determine the life and crop zones of these States, will be continued during the year on much the same lines as in past years.

General field work in Texas has been practically completed and it is expected that a report upon the birds of the State will be ready during the present year. The publication of a volume, with maps illustrating the life and crop zones of this large and important State, has been planned, but as yet funds will not admit of the final field investigations necessary to determine the crops best adapted to the several faunal areas. It is hoped that provision will be made for this work so that it can be completed during the next field season.

It is planned to send an assistant to Alaska in 1907 to investigate, among other matters, the subject of fox farming, an industry which seems to promise important results.

### ECONOMIC ORNITHOLOGY AND MAMMALOLOGY.

An important part of the work of this branch of the Survey for the coming year will be field investigations of epidemic diseases of rabbits and other rodent pests with a view to the discovery of effective means of destroying them on a large scale and at small cost.

Laboratory and field experiments in cooperation with the Bureau of Animal Industry to test the value of an imported virus in the destruction of field mice and rats will be continued.

The field and laboratory experiments with a bacterial virus for the destruction of spermophiles injurious to grain, in cooperation with

the State experiment station at Pullman, Wash., will be continued on a more extensive scale. Experiments also with this virus will be made to test its efficacy in the destruction of rats.

Two preliminary reports on the relation of birds to the boll weevil in Texas have been issued. The work will be continued in cooperation with the Bureau of Entomology in Texas and will be extended into Louisiana, into which State the weevil has already made its way and where it threatens the same disastrous results which have attended its presence in Texas.

The investigation of the food of California birds with special relation to the protection of orchards and vineyards will be continued during the present year, and a full report thereupon will be issued as soon as the necessary examinations of stomachs can be completed.

Investigations of the food habits of the rose-breasted grosbeak with particular relation to the destruction of the Colorado beetle are practically completed, and a report upon the subject will soon be ready for the press.

A report on the English sparrow, containing an account of its food-habits, methods of breeding and of distribution, together with suggestions for restricting its spread, was published in 1889. Since then, in spite of strenuous efforts to limit its increase, including the offering of bounties in many localities, the pest has greatly increased in numbers and has widely extended its range. Requests for information relative to it are constantly being received, and as the above report has long been out of print it is thought desirable to issue a revised report containing much data accumulated since the date of the former report and bringing the subject up to date.

A preliminary study of the present status of the wolf problem in the Western States, with a view to the discovery of methods for destroying the big gray or timber wolf, has been completed, except that certain work during the fall months is necessary to develop the best methods of trapping at that season. A report on the subject, prepared by the Biological Survey, will be published by the Forest Service.

It is intended to continue experiments for the purpose of preventing or limiting the damage by wolves and coyotes in the West. Coyotes, though smaller and less formidable than gray wolves, inflict considerable injury, especially to the sheep and poultry industries. Fencing experiments will be continued for the purpose of ascertaining the height and the size of mesh necessary for a coyote-proof fence which can be put up at a cost sufficiently low to render its general use to sheep raisers practicable.

Meadow mice are a perennial source of annoyance and danger to the nursery and orchard, as well as most destructive to pasturage and various crops. Attention will be paid to improving known methods of destroying them by means of poison and traps, as well as to experimenting with a virus for thinning their numbers by disease.

#### GAME PROTECTION.

##### IMPORTATION.

Further improvement in the work of supervising importations of foreign animals and birds will be instituted on July 1, 1906, which it is expected will not only facilitate the issue of permits, but will serve



as a further check thereon. A notice of the issue of each permit will be forwarded by the same mail to the collector of customs at whose port the entry is to be made, and at the close of the quarter the original permits will be returned to this Bureau through the Treasury Department with a report from the collector. In this way each collector will be advised of the permits drawn on his port, and the receipt of the permits by the Department will show which have been used.

The consolidated card index of species imported into the United States begun last year will probably be completed in the course of a few months. It will furnish a record of the wild birds and animals imported since the passage of the Lacey Act of 1900, with the date of entry and number of birds of each species or in any one shipment.

#### INTERSTATE COMMERCE IN GAME.

Attention will be centered in Oklahoma and the Southwest, where new problems are presented which call for careful and comprehensive investigation. Preliminary arrangements for conducting cooperative work during the open season of 1906 have already been made between the Department and two of the States most intimately concerned. Attention will be given also to the violations of the Federal law frequently reported from the States of Virginia, West Virginia, and North Carolina, and an attempt made to diminish the number of illegal shipments from these States. In this connection the fact can not be too strongly emphasized that the Department has never had the means to properly discharge the duties placed upon it by the Lacey Act. In the absence of adequate appropriation it has been impossible to give this feature of the work the personal supervision it requires, or to organize it on a systematic and thorough basis. In order to carry out properly the provisions relating to interstate commerce in game it is necessary that the territory east of the Rocky Mountains, which supplies most of the game forwarded to eastern markets, be divided into at least three districts, each in charge of a supervisor responsible for maintaining careful scrutiny over the express and freight shipments, and who should be required to investigate reports of violations and cooperate with State officers in obtaining the evidence necessary for the apprehension and prosecution of violators of the law. These districts should be as follows: A northwestern, comprising the States from Michigan to Montana and Ohio to Nebraska, with headquarters at Chicago; a southwestern, comprising the States from Kentucky to Tennessee and Mississippi to Colorado, with headquarters at St. Louis; and a southeastern, comprising the States from Maryland to Alabama, with headquarters at Baltimore. In the past wherever personal aid has been given to State officials excellent results have followed; but, owing to the rigid economy heretofore necessary, it has been impossible to accede to many of the requests for such cooperation. Active and intelligent work on the part of such Federal supervisors would constitute an effective check on illegal shipments of game, would create a wholesome respect for the Federal law prohibiting such shipments, and would enable the Department to handle the cases much more systematically and effectively than is now possible. The services of supervisors for this special work would not be required during the entire year, perhaps for not more than six months (during the open

season for game), but a sufficient sum for traveling expenses should be allowed to enable the supervisors to cover their districts and for special investigations.

## GAME REFUGES.

The attention given to Federal refuges in recent sessions of Congress, and the misapprehension on the part of many persons in regard to the subject, indicate the desirability of early publication of all available data on this important subject. An investigation has already been begun, and information will be secured concerning the character and extent of refuges or game preserves in foreign countries, the manner in which they are maintained, and the degree of success which has followed their establishment.

In the past three years seven bird refuges established by Executive order have been placed in charge of the Secretary of Agriculture and their administration has been intrusted to the Biological Survey. In cooperation with the National Association of Audubon Societies, warden service has been established on each of these reservations, but to secure the best results and fully attain the object for which these preserves were established, they should be frequently inspected and steps should be taken to protect more effectively the birds nesting on them. A small expenditure for this purpose will yield large returns and make of some of the reserves, such as Pelican Island in Florida, important points of attraction for the States in which they are located.

The private preserves of the United States, which are now numbered by hundreds, and the combined area of which greatly exceeds that of existing Federal preserves, should also be the subject of investigation to ascertain their location and area and the methods under which they are maintained. Some progress in this direction has already been made, but their rapidly increasing number and the lack of means prevent thorough investigation.

## COOPERATIVE WORK.

Cooperation with the Forest Service will be continued for the purpose of devising the best methods of increasing the stock of game on the Federal refuges which have been established in Oklahoma and Arizona. Cooperation with the State wardens and commissioners for the purpose of enforcing the provisions of the Lacey Act and restricting the shipment of game in violation of the Federal law will likewise be continued as heretofore. Cooperative work with the New York State library in indexing the game laws will be continued, and it is hoped that before the close of the year all of the States west of the Missouri River will have been covered.

The events of the past spring have demonstrated the necessity of immediately devising means of obtaining game birds, especially quail, for propagation. In cooperation with a committee of the American Breeders' Association it is expected to make at least preliminary investigations to ascertain what has been accomplished in this field, especially in rearing quail, grouse, pheasants, and ducks in captivity or in a state of semidomestication. Consideration will be given also to the possibility of developing certain breeds of pheasants or other game birds adapted to the conditions of the regions that need restocking.

**RECOMMENDATIONS.**

In submitting estimates for the fiscal year 1908 the following recommendations are made:

(1) That an increase of \$2,200 in the statutory roll be granted to be applied as follows: \$1,200 for the employment of a stenographer and typewriter whose services are necessary on account of the greatly increased work in the business office of the Bureau; and \$1,000 for an additional clerk whose services are needed in the Office of Game Protection.

(2) That an increase of \$11,500 in the lump appropriation be granted as follows: For field investigations, chiefly in relation to methods of controlling the ravages of rodent mammals, including studies of epidemic bacterial diseases, \$3,000; for field work in locating the boundaries of crop belts and for work on geographic distribution, \$1,000; for work in economic ornithology and mammalogy, \$1,000; for special investigations in connection with the depredations of wolves, coyotes, and panthers, and other carnivorous animals on stock ranges, game refuges, and forest reserves, \$2,500; for salaries and traveling expenses on account of supervision of interstate commerce in game, \$2,000; for miscellaneous field expenses for Office of Game Protection, \$1,000; for the payment of inspection fees on entry of foreign birds and animals, \$1,000.

Total increase, \$13,700.



## REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

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U. S. DEPARTMENT OF AGRICULTURE, -  
DIVISION OF ACCOUNTS AND DISBURSEMENTS,  
*Washington, D. C., September 10, 1906.*

SIR: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1906.

Very respectfully,

A. ZAPPONE,  
*Chief of Division.*

HON. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### CHANGE IN CHIEF OF DIVISION.

During the year Mr. F. L. Evans, Chief of Division, resigned, owing to failing health, and Mr. A. Zappone, the assistant chief of the Division, was appointed as his successor. Mr. Evans was an employee of the Department for thirty-one years, during which time he filled every position from laborer to Disbursing Officer. When Mr. Evans entered the Department in 1875 there were less than 100 employees. Now there are more than 6,000. He was first employed in the Seed Division at a salary of \$1.50 a day, but was soon transferred to the Division of Statistics at an increased salary, where he worked out by actual computation what is now known as the "cotton belt," a line indicating the cotton-growing area of the United States. In 1882 he became bookkeeper in the Division of Accounts, and in 1890 was made cashier of the Department, which position he filled acceptably until 1893, when he was made Chief of the Division of Accounts and disbursing clerk. During Mr. Evans's incumbency of this Division he made an excellent record for accuracy and careful methods, and disbursed during this time over \$54,000,000, and not a dollar was lost or unaccounted for. He also contributed greatly to the development of the Department by his intelligent vigilance over expenditures.

#### CHANGE IN ASSISTANT CHIEF OF DIVISION.

Mr. E. B. Calvert, chief of division in the Weather Bureau at \$2,000, was appointed assistant chief of the Division of Accounts to succeed Mr. A. Zappone, promoted to Chief of Division. Mr. Calvert has been connected with the Weather Bureau for a number of years, and while acting as confidential clerk and private secretary to the Chief of Bureau, handled the accounts of the Weather Bureau and gave them a close examination before their approval by the Chief of the Bureau. This and his general knowledge of Weather Bureau matters especially qualified him for the position of assistant chief of this Division.

## APPROPRIATIONS, EXPENDITURES, ETC.

The total appropriations for the Department for the year ended June 30, 1906, amounted to \$7,175,690, not including \$720,000 and \$240,000, appropriated for the several State agricultural experiment stations. Of this sum (\$7,175,690) \$6,000,327.85 was disbursed prior to the close of the year, leaving a balance of \$1,175,362.15, nearly all of which is covered by outstanding liabilities. Supplemental accounts for the year 1905 were also paid, amounting to \$251,004.90. The unexpended balances for the year 1904, amounting to \$55,712.37, were finally covered into the Treasury on June 30, 1906.

There were received, audited, and paid 41,159 accounts, as follows: Weather Bureau, 11,005, amounting to \$1,187,550.51; Bureau of Animal Industry, 7,094, amounting to \$1,304,421.71; all other bureaus and divisions, 23,060, amounting to \$3,508,355.63, a total of \$6,000,327.85. In payment of these accounts 48,235 checks were drawn on the Treasury at Washington and subtreasuries at New York and at Chicago.

There were also audited and sent to the Treasury Department for payment 2,087 accounts, including 416 for the Weather Bureau.

## LOST CHECKS.

During the year 18 checks were lost in transit through the mails or by the payees.

## REQUISITIONS, LETTERS, REQUESTS, CONTRACTS, AND LEASES.

One hundred and eighty-three requisitions were drawn on the Treasury, aggregating \$5,511,570.65.

The number of requisitions issued for supplies was 14,192.

The number of letters of authorization for travel was 2,435.

The number of letters written and received in the ordinary transaction of business was 53,178.

The number of requests for passenger transportation was 8,547.

The number of requests on the Quartermaster-General for the transportation of Government property was 2,014.

The number of leases and agreements executed and in effect was 512.

The number of contracts for supplies, etc., was 160.

The amount expended for telegraphing and telephoning by the Weather Bureau, including the West Indian cable service, was \$225,470.

## NEW BUILDINGS FOR DEPARTMENT.

Up to the present time Congress has appropriated for the purpose \$1,250,000, of which sum there has been expended \$642,107.25, leaving a balance on September 10, 1906, of \$607,892.75.

## TEMPORARY SPECIAL DISBURSING AGENTS.

There were 12 temporary special disbursing agents appointed during the year, and the sum of \$83,782.95 from the appropriations of the Department was advanced, requiring the issuance of 59 requisitions upon the Treasury. All accounts of temporary special disbursing agents of this Department are given an administrative examination in this division before being forwarded to the Treasury Department for final audit.

# APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE FISCAL YEAR 1906.

The table following shows for the fiscal year the amounts appropriated, disbursed, and unexpended:

Object.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Salaries, Department of Agriculture, officers and clerks .....	\$804,970	\$782,913.30	\$22,056.70
Salaries, extra labor .....	10,000	8,820.34	1,179.66
Bureau of Animal Industry:			
Deficiency appropriation .....	63,000	29,863.06	33,136.94
General expenses .....	1,429,020	1,256,254.31	172,765.69
Animal breeding and feeding .....	25,000	16,651.32	8,348.68
Rent of buildings .....	2,500	1,653.02	846.98
Bureau of Plant Industry:			
Vegetable pathological investigations .....	139,640	122,341.52	17,298.48
Rent of building .....	6,000	3,070.00	2,930.00
Vegetable pathological investigations, 1905-6 .....	10,000	7,278.05	2,721.95
Grain investigations .....	25,000	20,040.29	4,959.71
Pomological investigations .....	33,640	32,464.49	1,175.51
Rent of building .....	2,000	1,870.00	130.00
Botanical investigations and experiments .....	60,840	54,517.26	6,322.74
Rent of building .....	3,000	2,750.00	250.00
Grass and forage plant investigations .....	37,160	30,768.51	6,391.49
Rent of building .....	2,500	1,375.00	1,125.00
Experimental gardens and grounds .....	15,320	13,887.04	1,432.96
Experimental gardens and grounds, 1905-6 .....	5,000	4,807.82	192.18
Arlington Experimental Farm .....	20,000	19,040.13	959.87
Tea-culture investigations .....	8,500	6,910.79	1,589.21
Purchase and distribution of valuable seeds .....	195,140	186,325.12	8,814.88
Foreign seed and plant introduction .....	37,780	28,406.09	9,373.91
Repairs to building .....	10,000	.....	10,000.00
Investigating production of domestic sugar .....	7,500	6,459.06	1,040.94
Forest Service:			
General expenses .....	768,180	722,031.96	46,148.04
Rent of buildings .....	25,000	14,056.85	10,943.15
Bureau of Chemistry, laboratory, including \$3,000 for table sirup .....	130,920	117,359.87	13,560.13
Bureau of Soils, soil investigations, including \$4,000 for rent of building .....	170,000	162,268.42	7,731.58
Bureau of Entomology, entomological investigations, including \$2,500 for moth investigations .....	68,060	63,292.82	4,767.18
Bureau of Biological Survey, biological investigations .....	44,420	42,534.43	1,885.57
Publications:			
Farmers' Bulletins .....	98,750	96,461.42	2,288.58
Artists, etc. ....	3,500	3,427.08	72.92
Labor, etc. ....	30,000	28,036.26	1,963.74
Bureau of Statistics:			
Collecting agricultural statistics .....	93,900	82,104.53	11,795.47
Foreign market investigations .....	4,900	4,720.13	179.87
Library .....	8,040	6,287.16	1,752.84
Contingent expenses .....	35,000	30,597.94	4,402.06
Contingent expenses, 1905-6 .....	2,000	2,000.00	.....
Agricultural experiment stations (\$794,660 <sup>a</sup> ) .....	21,660	20,009.87	1,650.13
Stations of Alaska, including \$3,000 for purchase of live stock .....	18,000	16,800.00	1,200.00
Stations of Hawaii .....	15,000	15,000.00	.....
Stations of Porto Rico .....	15,000	15,000.00	.....
Farmers' Institutes .....	5,000	4,024.57	975.43
Nutrition investigations .....	20,000	17,594.28	2,405.72
Irrigation investigations .....	74,200	66,156.35	8,043.65
Public Road Inquiries .....	37,660	32,487.49	5,172.51
Cotton boll weevil investigations .....	190,000	143,014.07	46,985.93
Building .....	950,000 (\$250,000 700,000)	469,065.32	480,934.68
Total .....	5,782,700	4,812,777.34	969,922.66
WEATHER BUREAU.			
Salaries .....	191,430	190,930.72	499.28
Fuel, lights, and repairs .....	10,000	9,112.13	887.87
Contingent expenses .....	10,000	7,879.65	2,120.35
Salaries, station employees .....	531,550	487,988.40	43,561.60
General expenses .....	562,010	405,296.62	156,713.38
Buildings .....	53,000	52,716.93	283.07
Cables and land lines .....	35,000	33,626.06	1,373.94
Total .....	1,392,990	1,187,550.51	205,439.49
Grand total .....	7,175,690	6,000,327.85	1,175,362.15

<sup>a</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.



## MONTHLY CHECK STATEMENTS.

The check statements submitted by the Treasury and subtreasuries were compared with the checks issued by this Division, and the amounts verified.

## ANNUAL SUPPLIES.

Annual supplies for the use of the various branches of the Department were freely advertised for in the usual manner and at a uniform time with the other Executive Departments, and contracts were made covering as nearly as practicable all the lines of supplies needed during the year. The method pursued by this Department in advertising for supplies and in obtaining competition thereon is thought to accomplish the object sought very fully. Advertising is done not only through the medium of daily newspapers in the large cities for a certain period before the supplies are needed, but hundreds of copies of the advertisement in the form of a printed slip are mailed to known dealers in the wares required. All bids are submitted to and are passed upon by a board of award acting under the instructions and by the authority of the Secretary. Supplies aggregating an amount less than \$50 may, under the act of March 1, 1899, be purchased in the open market.

## PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from various sources and deposited in the Treasury to the credit of the proper funds the following sums:

Sales of condemned property.....	\$4, 384. 93
Sales of card index .....	142. 73
Sales of publications, Weather Bureau.....	655. 49
Telegraph-line receipts, Weather Bureau.....	3, 216. 84
Sales of American dairy products in Europe.....	797. 30
Sales of experimental shipments of fruits.....	3, 437. 33
Sales of products, agricultural station, Hawaii.....	625. 99
Sales of products, agricultural station, Porto Rico.....	1, 164. 52
Sales of products, agricultural station, Alaska .....	350. 70
Sales of copies of the Library card index.....	1. 70
Total .....	15, 473. 45

Beginning with July 1, 1904, the proceeds of sales of card index of agricultural literature were made available until used, instead of, as heretofore, lapsing with the fiscal year. The same applies to the sales of experimental shipments of fruits, etc., to Europe, beginning July 1, 1905.

In this connection it is thought desirable to explain the method pursued in receiving and disposing of the moneys pertaining to the several funds.

The proceeds of "condemned property" are covered into the Treasury to the credit of "Miscellaneous receipts," under section 3618 of the Revised Statutes.

The moneys received from the sale of "card index of agricultural literature" prepared by the Office of Experiment Stations is covered into the Treasury to the credit of that appropriation, as provided by the appropriation act.

Proceeds of "dairy and other farm products of the United States" are covered into the Treasury to the credit of the appropriation "Expenses, Bureau of Animal Industry," by authority of said act.

All proceeds of "experimental shipments of fruits and vegetables to foreign countries" are deposited in the Treasury to the credit of the appropriation "Pomological investigations," as provided by that act.

Moneys derived from the sales of certain "publications" issued by the Weather Bureau are deposited in the Treasury to the credit of the appropriation "General expenses" of that Bureau, under section 227 of the Revised Statutes.

"Seacoast telegraph line receipts" are covered into the Treasury under act of March 3, 1883 (22 Stat. L., 616).

Proceeds of the "card index" prepared by the Library are deposited in the Treasury to the credit of the Library fund of the Department, provided for by the appropriation act.

In acknowledgment of each deposit of funds the Treasurer issues to the depositor a duplicate certificate of deposit. The number of this certificate is entered as part of the transaction, and the certificate is pasted in the journal opposite the entry.

These moneys are forwarded to the Division of Accounts and Disbursements from the various Bureaus, Divisions, and Offices of the Department, accompanied by a letter, or specially printed form, in duplicate, explaining from whence the money was derived. The duplicate is receipted by the Chief of this Division and returned to the sender. The original is placed in the files of this Division as a voucher. The amount received is entered in a book with a description of the transaction copied from the letter of transmittal. If in the form of cash or postal money order, it is so stated in the entry, and if by check or draft a minute description is given, with name of payor, payee, indorser, name of bank, number and date of check, etc. The law requires that money so received shall be deposited in the Treasury within thirty days after its receipt by a Government officer. The practice in this office is to deposit all sums as soon as practicable after they are received, unless of an insignificant amount. The Chief of this Division, having no authority to do otherwise, accepts the statements accompanying sums of money submitted to him, assuming them to be in strict accordance with the facts.

The method of receiving and accounting for special funds, as mentioned above, has been the subject of considerable correspondence with the Treasury Department during the year, and with the view of meeting the wishes of that Department, two different plans were submitted to the Comptroller for his approval. The first one was disapproved by him and the second one he now has under consideration. Whatever changes are desired by the Comptroller in receiving and accounting for these funds will be adopted.

#### ACCOUNTS FOR THE FISCAL YEAR 1904 FINALLY CLOSED.

By section 5, legislative act, approved June 20, 1874 (18 Stat. L., 110-111), the unexpended balances of the appropriations for the year

1904 were finally covered into the Treasury on June 30, 1906, and carried to the surplus fund, as follows:

*Amount of unexpended balances for fiscal year 1904 turned into the Treasury.*

Object.	Amount ap- propriated for 1904.	Amount disbursed.	Amount un- expended.
Salaries.....	\$471,080.00	{ \$458,295.90 982.01	\$11,784.10 17.99
Bureau of Animal Industry:			
General expenses, including \$1,800 for rent of building...	1,200,000.00	1,199,410.98	589.02
To eradicate contagious diseases of animals.....	250,000.00	249,868.64	131.06
Bureau of Plant Industry:			
Vegetable pathological investigations.....	122,000.00	122,889.98	.06
Rent of building.....	3,000.00	2,109.96	.....
Vegetable pathological investigations, 1903-4.....	5,000.00	4,998.41	1.59
Pomological investigations.....	37,000.00	35,636.08	1,363.92
Botanical investigations and experiments.....	62,000.00	60,693.23	1,306.77
Rent of building.....	3,000.00	3,000.00	.....
Grass and forage plant investigations.....	33,800.00	34,514.48	235.52
Rent of building.....	1,200.00	250.00	.....
Experimental gardens and grounds.....	25,000.00	24,984.11	15.89
Arlington Experimental Farm.....	15,000.00	14,972.99	27.01
Tea-culture investigations.....	10,000.00	8,701.07	1,298.93
Purchase and distribution of valuable seeds.....	<sup>a</sup> 257,000.00	257,247.74	256.26
Foreign seed and plant introduction.....	<sup>a</sup> 30,000.00	27,483.93	2,012.07
Rent of building.....	3,000.00	.....	3,000.00
Investigating production of domestic sugar.....	5,000.00	4,249.41	750.59
Bureau of Forestry:			
Forestry investigations, including \$10,000 for rent of building.....	312,860.00	311,588.63	1,271.37
Protection of forest reserves <sup>b</sup> .....	16,864.01	341.12	16,522.89
Bureau of Chemistry:			
Laboratory, including \$5,000 for table sirup.....	60,500.00	60,317.39	182.61
Laboratory, table sirup, 1903-4.....	10,000.00	9,898.89	101.11
Bureau of Soils, soil investigations, including \$2,000 for rent of building.....	170,000.00	166,286.32	3,713.68
Entomological investigations.....	43,500.00	39,114.76	4,385.24
Silk investigations.....	10,000.00	9,055.31	944.69
Entomological investigations, 1903-4.....	12,000.00	11,825.82	174.18
Biological investigations, including \$1,000 for care of game ..	34,000.00	33,066.92	933.08
Publications:			
Farmers' bulletins.....	105,000.00	104,997.90	2.10
Artists, etc.....	10,000.00	9,992.49	7.51
Labor, etc.....	85,000.00	84,746.78	253.27
Collecting agricultural statistics.....	104,200.00	103,225.90	974.10
Collecting agricultural statistics, 1903-4.....	5,000.00	4,996.84	3.16
Foreign market investigations.....	7,500.00	7,455.40	44.60
Library.....	10,000.00	9,972.93	27.07
Contingent expenses.....	37,000.00	36,999.77	.23
Agricultural experiment stations (\$810,000 <sup>c</sup> ).....	40,000.00	39,997.74	2.26
Stations of Alaska.....	15,000.00	15,000.00	.....
Stations of Hawaii.....	15,000.00	15,000.00	.....
Stations of Porto Rico.....	15,000.00	15,000.00	.....
Farmers' institutes.....	5,000.00	4,838.69	161.31
Nutrition investigations.....	20,000.00	19,994.18	5.82
Irrigation investigations.....	65,000.00	64,938.65	61.35
Public Road Inquiries.....	32,000.00	31,813.00	187.00
Public Road Inquiries, 1903-4.....	3,000.00	3,000.00	.....
Total.....	3,776,504.01	3,723,754.30	52,749.71
WEATHER BUREAU.			
Salaries.....	175,440.00	175,098.94	341.06
Fuel, lights, and repairs.....	6,000.00	5,981.63	18.37
Contingent expenses.....	8,000.00	7,818.52	181.48
General expenses, salaries.....	472,300.00	471,917.22	382.78
General expenses, miscellaneous.....	496,780.00	494,741.03	2,038.97
Buildings.....	50,000.00	50,000.00	.....
Cables and land lines.....	40,000.00	40,000.00	.....
Total, Weather Bureau.....	1,248,520.00	1,245,557.34	2,962.66
Grand total.....	5,025,024.01	4,969,311.64	55,712.37

<sup>a</sup> \$504 transferred from foreign to domestic seeds.

<sup>b</sup> This appropriation and amount transferred from Department of Interior.

<sup>c</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.



## IMMEDIATELY AVAILABLE APPROPRIATIONS.

The following sums were made immediately available for the year 1906:

Vegetable pathological investigations, \$10,000, from which payments were made amounting to \$4,670.83 before the ensuing year.

Experimental gardens and grounds, \$5,000, from which payments were made amounting to \$2,672.82 before the ensuing year.

Contingent expenses, \$2,000, of which sum nothing was expended prior to the ensuing fiscal year.

## BUILDINGS UNDER LEASE IN THE DISTRICT OF COLUMBIA.

The following statement shows the buildings under lease in the District of Columbia on June 30, 1906:

	Rate per annum.
Office of Secretary: Rooms for storage, 611 Maryland avenue SW.....	\$300.00
Bureau of Animal Industry: Laboratories and offices, 1358 and 1362 B street SW.....	2,400.00
Bureau of Plant Industry:	
Vegetable pathological and physiological investigations, laboratories and offices, 1304-1306 B street SW., 1308 B street SW., and 201 Thirteenth street SW.....	\$3,720.00
Botanical investigations and experiments, laboratories and offices, 224 Twelfth street SW.....	3,000.00
Grass and forage plant investigations, offices, 1316 B street SW.....	1,500.00
Purchase and distribution of valuable seeds, seed warehouse, 221 Thirteen-and-a-half street SW.....	3,000.00
Pomological investigations, offices, 203, 205, 207, 207½, and 209 Thirteenth street SW.....	2,040.00
	<hr/> 13,260.00
Forest Service, offices and storage rooms:	
Atlantic Building, 930 F street NW.....	14,778.96
Washington Loan and Trust Building, Ninth and F streets NW., 2 rooms.....	570.00
913 E street NW.....	270.00
928 Baptist alley.....	120.00
Building in Baptist alley.....	270.00
Twenty-sixth and D streets NW.....	120.00
	<hr/> 16,128.96
Bureau of Chemistry: Laboratories and offices, 200-202 Fourteenth street SW. and 206 Fourteenth street SW.....	2,800.00
Bureau of Soils: Laboratories and offices, 208, 212-214 Thirteenth street SW.....	3,920.00
Bureau of Entomology: Offices, 904 B street SW.....	720.00
Division of Publications:	
Document rooms, 215 Thirteenth street SW.....	\$5,000.00
Storage room, 916-918 Pennsylvania avenue NW.....	60.00
	<hr/> 5,060.00
Office of Public Roads: Laboratories and offices, 237 Fourteenth street SW.....	2,000.00
Total.....	<hr/> 46,588.96

## ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1907, were prepared in this Division, based upon recommendations made by the chiefs of the several Bureaus and Divisions, and after receiving the approval of the Secretary were forwarded to the Treasury in accordance with statutory requirements.

## APPROPRIATIONS AND ESTIMATES FOR 1907.

*Estimates for 1907.*

Salaries.....	\$849,140.00
Library.....	10,000.00
Contingent expenses.....	37,000.00
Bureau of Animal Industry, general expenses.....	1,729,000.00
Vegetable pathological investigations.....	163,800.00
Grain investigations.....	25,000.00
Pomological investigations.....	60,640.00
Botanical investigations and experiments.....	80,540.00
Grass and forage plant investigations.....	39,660.00
Experimental gardens and grounds.....	20,320.00
Arlington Experimental Farm.....	20,000.00
Horticultural investigations.....	10,000.00
Tea-culture investigations.....	8,500.00
Purchase and distribution of valuable seeds.....	252,920.00
Investigating production of domestic sugar.....	7,500.00
Forest Service, general expenses.....	918,040.00
Bureau of Chemistry, laboratory.....	162,980.00
Soil investigations.....	200,000.00
Entomological investigations.....	113,810.00
Biological investigations.....	51,920.00
Publications.....	133,750.00
Collecting agricultural statistics and foreign market investigations.....	118,800.00
Agricultural experiment stations.....	813,120.00
Nutrition investigations.....	25,000.00
Irrigation investigations.....	82,520.00
Public Road Inquiries.....	67,660.00
Cotton boll weevil investigations.....	105,500.00

Total.....	6,107,120.00
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## WEATHER BUREAU.

Salaries.....	194,530.00
Fuel, lights, and repairs.....	10,000.00
Contingent expenses.....	10,000.00
Salaries, station employees.....	551,550.00
General expenses.....	693,010.00
Buildings.....	60,000.00

Total.....	1,519,090.00
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Grand total.....	7,626,210.00
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*Appropriated for 1907.*

Salaries officers and clerks.....	\$748,870
Salaries, Department of Agriculture, extra labor.....	7,600
	756,470.00
Library.....	10,000.00
Contingent expenses.....	37,000.00
Bureau of Animal Industry:	
General expenses.....	809,700
Rent of buildings.....	2,500
Southern dairy work.....	20,000
Diseases of domestic animals, Minnesota.....	5,000
Animal breeding and feeding.....	25,000
	862,200.00
Meat inspection.....	3,000,000.00
Eradicating cattle ticks.....	82,500.00

Bureau of Plant Industry:		
General expenses.....	\$471,260	
Rent and repairs .....	19,000	
Ozark Mountain investigations.....	5,000	
		\$495,260.00
Grain investigations.....		15,000.00
Improving roads .....		3,500.00
Purchase and distribution of valuable seeds .....	205,140	
Foreign seed and plant introduction .....	32,780	
Erection of building at Chico, Cal .....	5,000	
		242,920.00
Cotton boll weevil investigations .....		105,000.00
Bureau of Chemistry, laboratory .....		145,920.00
Bureau of Soils, soil investigations.....	181,000	
Rent of buildings.....	4,000	
		185,000.00
Bureau of Entomology:		
Entomological investigations.....	70,000	
White fly investigations.....	5,000	
		75,000.00
Cotton boll weevil investigations .....		85,000.00
Preventing spread of moths .....		82,500.00
Bureau of Biological Survey, biological investigations.....		44,420.00
Division of Publications:		
Publications, Farmers' Bulletins.....	98,750	
Artists, etc.....	3,500	
Labor, etc .....	30,000	
		132,250.00
Bureau of Statistics:		
Collecting agricultural statistics .....	108,000	
Foreign markets investigations .....	4,900	
		112,900.00
Office of Experiment Stations:		
Agricultural experiment stations (\$803,500 <sup>a</sup> ).....	25,500	
Farmers' institutes .....	5,000	
Station at Alaska, including \$3,000 for purchase of live stock .....	18,000	
Station at Hawaii, including \$5,000 for water supply .....	20,000	
Station at Porto Rico .....	15,000	
		83,500.00
Nutrition investigations .....		20,000.00
Irrigation investigations .....		122,200.00
Office of Public Roads, public road inquiries .....		57,660.00
Total for main Department, exclusive of Weather Bureau and Forest Service.....		6,756,200.00
WEATHER BUREAU.		
Salaries.....		194,690.00
Fuel, lights, and repairs.....		10,000.00
Contingent expenses.....		10,000.00
Salaries, station employees.....		541,550.00
General expenses.....		630,000.00
Buildings .....		53,000.00
Total for Weather Bureau .....		1,439,240.00

<sup>a</sup> This includes \$720,000 for State experiment stations paid through the Treasury Department. Congress has also appropriated \$336,000 for State experiment stations under the Adams bill, to be paid through the Treasury Department. Total paid through the Treasury Department for State experiment stations, \$1,056,000.



## FOREST SERVICE.

Salaries, officers and clerks.....	\$112,860.00
General expenses.....	\$849,640
Rent.....	35,000
Building on Dismal River Forest Reserve.....	2,500
	<hr/>
	887,140.00
Wichita Forest and Game Preserve.....	15,000.00
	<hr/>
Total for Forest Service (regular appropriations) .....	1,015,000.00
	<hr/>
Total of all regular appropriations for entire Department.....	9,210,440.00

## SPECIAL APPROPRIATIONS.

Building, Department of Agriculture .....	{ \$250,000
	{ 700,000
Balance available on July 1, 1906.....	\$480,934.68
Sundry civil act June 30, 1906.....	300,000.00
	<hr/>
	780,934.68
Administration, etc., forest reserves .....	700,000.00
	<hr/>
Grand total of all appropriations available for the Department for the fiscal year 1907.....	10,691,374.68

## SPECIAL FISCAL AGENT FOR FOREST SERVICE.

Mr. James B. Adams was appointed a special fiscal agent for the Forest Service on July 1, 1905, with authority to disburse the appropriations of that Bureau, and for the purpose of having a record of all the fiscal affairs of the Department in one report, so that it may be of easy reference to the Secretary and others interested therein, the following statement furnished by the Forest Service is printed:

*Statement of the fiscal transactions of the Forest Service.*

Requisitions issued for the purchase of supplies.....	1,971
Letters of authorization issued for travel .....	815
Accounts paid during the fiscal year 1906, including those paid from cooperative fund .....	13,343
Accounts paid from the appropriations for 1906, including the coopera- tive fund .....	\$1,064,976.86
Supplemental accounts paid from the appropriation for the fiscal year 1905 .....	\$61,957.54
Checks drawn during the year above named in payment of accounts for 1906, and supplemental accounts of 1905.....	12,920
Requisitions on the Quartermaster's Department for freight transpor- tation .....	112
Passenger transportation requests issued .....	2,289
Money received from sales of condemned property.....	\$140.25
Money received from timber sales, etc .....	\$767,219.96
Money for cooperative work .....	\$15,382.50
Requisitions drawn on the Treasury for advances of money (52), ag- gregating .....	\$1,061,500.00

## DEFICIENCY APPROPRIATIONS.

For general expenses, Bureau of Animal Industry, to meet the demands for more meat inspection and for microscopic inspection of pork, \$63,000.

For contingent expenses, to meet claims of merchants for contingent supplies furnished to the Department, \$156.20.

For Library, to meet claim of G. E. Stechert for publications furnished, \$767.60.

## INCREASE IN SALARY.

The salary of the Solicitor of the Department was increased from \$2,500 to \$3,000, to take effect July 1, 1906.

## CASHIER.

A recommendation was made to Congress for an increase in the salary of the cashier from \$1,800 to \$2,000, in order to give promotion to a very efficient, hard-working, and honest employee. The Senate passed it but it failed in conference committee. It will be resubmitted in the estimates for next year.

## LITTLEFIELD REPORT.

In addition to the annual report to Congress of the expenses of the Department for the fiscal year 1905, required by law, Hon. C. E. Littlefield, chairman of the Committee on Expenditures in the Department of Agriculture, House of Representatives, under date of March 19, 1906, called on the Secretary of Agriculture for a classified statement of the expenditures in the Department of Agriculture. This work involved considerable clerical labor and expense, but was promptly submitted to Mr. Littlefield. A resolution was then introduced by Mr. Littlefield and passed by Congress authorizing him to make inquiry into the expenditures of this Department, and it is understood the committee will begin the work in the fall. A recapitulation of the expenditures of the Department will be found below, classified as desired by the committee.

*Recapitulation of the several appropriations for the entire Department of Agriculture as distributed among the following groups, and the total expenditures under each.*

Statutory salaries.....	\$649,922.52
Lump-fund salaries in Washington.....	825,427.59
Lump-fund salaries outside of Washington.....	2,371,307.34
Stationery.....	76,070.47
Miscellaneous supplies and services, equipment, books, apparatus, machinery, and laboratory materials of all kinds.....	852,457.54
Furniture.....	41,155.31
Fuel.....	20,054.70
Freight.....	16,796.62
Express.....	8,968.98
Telegraph.....	218,390.31
Telephone.....	18,522.41
Rent.....	109,316.54
Gas and electricity.....	\$13,102.04

Traveling expenses.....	\$446,990.30
Station and field expenses.....	53,691.71
Printing.....	92,065.39
Total for entire Department of Agriculture.....	<u>5,814,239.77</u>
Total appropriations for Department of Agriculture.....	6,134,757.95
Total expenditures under above groups.....	<u>5,814,239.77</u>
Balance .....	320,518.18
Advances to temporary disbursing agents.....	\$74,916.39
To amount appropriated for Museum, which was not used but turned back into Treasury.....	2,260.00
	<u>77,176.39</u>
	243,341.79
Repayments to appropriations through Treasury .....	<u>893.31</u>
Unexpended balance .....	244,235.10
Of this amount the balance under the permanent appropriation for "building Department of Agriculture," on June 30, 1905, which is available until used, was.....	168,297.27
Making the unexpended balance.....	<u>75,937.83</u>

## CONDITION OF WORK IN THE DIVISION.

The work of the Division is up to date, but to keep it so with the present small force is a physical impossibility. The appropriations have increased annually, but there has been no corresponding increase in the force. The force of this Division has remained practically unchanged for several years. In my estimates for next year I shall ask for several additional clerks to meet the additional demands imposed on this Division by the large increase in the appropriations for meat inspection and other purposes.



*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture from the fiscal year 1839 to the fiscal year 1906, inclusive.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collection of agricultural statistics, etc.	Mar. 3, 1839	5	354	9	1839	\$1,000.00	\$1,000.00	-----
	Aug. 26, 1842	5	533	26	1842	1,000.00	1,000.00	-----
	Mar. 3, 1843	5	642	1	1844	2,000.00	2,000.00	-----
	June 17, 1844	5	687	1	1845	2,000.00	2,000.00	-----
	Mar. 3, 1845	5	757	1	1846	3,000.00	3,000.00	-----
	Mar. 3, 1847	9	160	1	1847	3,000.00	3,000.00	-----
	Aug. 12, 1848	9	285	1	1848	3,500.00	3,500.00	-----
Chemical analyses of vegetable substances	do.	9	285	1	1848	1,000.00	1,000.00	-----
Collection of agricultural statistics, etc.	Mar. 3, 1849	9	364	1	1849	3,500.00	3,500.00	-----
Chemical analyses of vegetable substances	do.	9	364	1	1850	1,000.00	1,000.00	-----
Collection of agricultural statistics	Sept. 30, 1850	9	541	1	1850	4,500.00	4,500.00	-----
	Mar. 3, 1851	9	615	1	1851	5,500.00	5,500.00	-----
Collection of agricultural statistics and purchase of seeds.	Aug. 31, 1852	10	95	1	1852	5,000.00	5,000.00	-----
	Mar. 3, 1853	10	208	1	1853	5,000.00	5,000.00	-----
Collection of agricultural statistics and purchase, etc., of seeds	May 31, 1854	10	232	1	1854	10,000.00	10,000.00	-----
	Aug. 4, 1854	10	567	1	1855	50,000.00	50,000.00	-----
	Mar. 3, 1855	10	664	1				
Collection of agricultural statistics, etc., and purchase, etc., of seeds.	May 15, 1856	11	14	1	1856	30,000.00	30,000.00	-----
	Aug. 18, 1856	11	89	1	1857	75,000.00	75,000.00	-----
	Mar. 3, 1857	11	226	1	1858	60,000.00	60,000.00	-----
Information in relation to consumption of cotton.	do.	11	226	1	1858	3,500.00	3,157.25	\$342.75
	June 12, 1858	11	321	1	1859	60,000.00	60,000.00	-----
Collection of agricultural statistics, etc., and purchase, etc., of seeds.	Mar. 3, 1859	11	427	1	1860	40,000.00	40,000.00	-----
	June 25, 1860	12	108	1	1861	60,000.00	60,000.00	-----
	Mar. 2, 1861	12	217	1	1862	64,000.00	63,704.21	295.79
	Feb. 13, 1862	12	338	---				
Collection of agricultural statistics, etc., and purchase, etc., of seeds, including a deficiency appropriation of \$20,000, made March 3, 1863.	Mar. 1, 1862	12	350	1	1863	80,000.00	80,000.00	-----
Salaries.	Feb. 25, 1863	12	691	1	1864	5,000.00	5,000.00	-----
Collection of agricultural statistics, etc., and purchase, etc., of seeds.	do.	12	691	1	1864	87,000.00	87,000.00	-----
Culture of cotton and tobacco.	do.	12	691	1	1864	3,000.00	3,000.00	-----
Investigations with flax and hemp.	do.	12	691	1	1864	20,000.00	9,500.00	10,500.00
Purchase of sorghum seed.	Mar. 14, 1864	13	23	1	1864	2,000.00	2,000.00	-----
To rebuild shop in propagating garden.	do.	13	23	1	1864	800.00	800.00	-----
Postage.	do.	13	23	1	1864	1,320.00	1,320.00	-----
Furniture, carpets, fuel, etc.	do.	13	23	1	1864	650.00	650.00	-----
Salaries.	June 25, 1864	13	155	1	1865	38,300.00	38,300.00	-----
	July 2, 1864	13	350	2				
Contingent expenses.	June 25, 1864	13	155	1	1865	3,500.00	3,500.00	-----
Collecting agricultural statistics.	do.	13	155	1	1865	20,000.00	20,000.00	-----
Furniture, carpets, etc.	do.	13	155	1	1865	800.00	800.00	-----
Library and laboratory.	do.	13	155	1	1865	4,000.00	4,000.00	-----
Purchase and distribution of seeds.	do.	13	155	1	1865	61,000.00	61,000.00	-----
Experimental garden and grounds.	do.	13	155	1	1865	15,800.00	15,800.00	-----
To pay a debt incurred in preparing the Agricultural Report for 1861	July 2, 1864	13	350	2	1865	3,704.05	3,596.55	107.50
Rent, etc., of Commissioner's office.	July 4, 1864	13	381	3	1865	3,500.00	3,500.00	-----
Salaries.	Mar. 2, 1865	13	160	3	1866	46,726.59	46,726.59	-----
		13	455	1				

*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of ap- propriation act.	Reference to Statutes at Large.			Fis- cal year.	Amount appro- priated.	Amount disbursed.	Amount unex- pended.
		Vol.	Page.	Sec.				
Contingent expenses.....	Mar. 2, 1865	13	455	1	1866	\$7,500.00	\$7,500.00	.....
Collecting agricultural statis- tics.....	.....do.....	13	455	1	1866	20,000.00	20,000.00	.....
Purchase, etc, of seeds.....	.....do.....	13	160	3	1866	70,165.90	70,165.90	.....
Experimental garden and grounds, etc.....	.....do.....	13	455	1				
Salaries.....	.....do.....	13	160	3				
Contingent expenses.....	.....do.....	13	455	1	1866	23,395.33	23,395.33	.....
Salaries.....	July 23, 1866	14	201	1	1867	39,600.00	39,600.00	.....
Contingent expenses.....	.....do.....	14	201	1	1867	11,500.00	11,500.00	.....
Collecting agricultural statis- tics.....	.....do.....	14	201	1	1867	10,000.00	10,000.00	.....
Purchase of seeds.....	.....do.....	14	201	1	1867	115,200.00	115,200.00	.....
Experimental garden and grounds, etc.....	.....do.....	14	202	1				
Salaries.....	Mar. 30, 1867	15	28	1				
Experimental garden and grounds, etc.....	July 23, 1866	14	202	1	1867	22,800.00	22,800.00	.....
Salaries.....	Mar. 2, 1867	14	451	1	1868	38,020.00	38,020.00	.....
Contingent expenses.....	.....do.....	14	451	1	1868	13,000.00	13,000.00	.....
Collecting agricultural statis- tics.....	.....do.....	14	451	1	1868	10,000.00	8,406.34	\$1,593.66
Purchase, etc., of seeds.....	.....do.....	14	452	1	1868	85,200.00	85,200.00	.....
Museum.....	.....do.....	14	452	1	1868	10,000.00	10,000.00	.....
Experimental garden and grounds.....	.....do.....	14	452	1	1868	22,800.00	22,800.00	.....
To erect a building for the De- partment of Agriculture.....	.....do.....	14	464	1	1868	100,000.00	99,668.00	332.00
For certain goods and services furnished the Department.....	July 13, 1868	15	90	1	.....	37,604.70	37,604.70	.....
Salaries.....	July 20, 1868	15	105	1	1869	65,368.00	65,368.00	.....
Collecting agricultural statis- tics.....	.....do.....	15	106	1	1869	10,000.00	10,000.00	.....
Contingent expenses.....	.....do.....	15	196	1	1869	31,090.00	31,090.00	.....
Experimental garden and grounds.....	.....do.....	15	106	1	1869	23,500.00	23,500.00	.....
Purchase, etc., of seeds.....	.....do.....	15	106	1	1869	20,000.00	20,000.00	.....
Furniture, cases, and repairs ..	.....do.....	15	106	1	1869	22,635.00	22,635.00	.....
Salaries.....	Mar. 3, 1869	15	297	1	1870	69,240.00	67,720.00	1,520.00
Collecting agricultural statis- tics.....	.....do.....	15	298	1				
Investigations of cattle disease.	.....do.....	15	298	1	1870	15,000.00	15,000.00	.....
Contingent expenses.....	.....do.....	15	298	1	1870	15,000.00	12,695.60	2,304.40
Furniture, cases, and repairs ..	.....do.....	15	298	1	1870	13,200.00	13,200.00	.....
Experimental garden and grounds.....	.....do.....	15	298	1	1870	2,500.00	2,500.00	.....
Purchase, etc., of seeds.....	.....do.....	15	298	1	1870	21,500.00	21,500.00	.....
Salaries.....	July 12, 1870	16	245	1	1871	71,980.00	71,811.64	168.36
Collecting agricultural statis- tics.....	July 15, 1870	16	314	1				
Purchase, etc., of seeds.....	.....do.....	16	245	1	1871	15,000.00	15,000.00	.....
Experimental garden and grounds.....	.....do.....	16	246	1	1871	30,000.00	28,865.17	1,134.83
Contingent expenses.....	.....do.....	16	246	1	1871	53,200.00	53,200.00	.....
Furniture, cases, and repairs ..	.....do.....	16	302	1				
Collecting and modeling speci- mens of fruit.....	.....do.....	16	303	1				
Library.....	July 15, 1870	16	246	1	1871	8,100.00	8,100.00	.....
Herbarium.....	.....do.....	16	246	1	1871	4,700.00	4,700.00	.....
Laboratory.....	.....do.....	16	246	1	1871	1,000.00	1,000.00	.....
Folding room.....	.....do.....	16	246	1	1871	1,000.00	1,000.00	.....
Salaries.....	Mar. 3, 1871	16	489	1	1872	75,170.00	75,017.89	152.11
Collecting agricultural statis- tics.....	.....do.....	16	489	1	1872	15,000.00	14,059.36	940.64
Purchase and distribution of seeds, etc.....	.....do.....	16	489	1	1872	45,000.00	45,000.00	.....
Experimental garden and grounds.....	.....do.....	16	489	1	1872	36,800.00	36,800.00	.....
Contingent expenses.....	.....do.....	16	509	1				
Furniture, cases, and repairs ..	.....do.....	16	489	1				
Collecting and modeling speci- mens of fruit.....	.....do.....	16	490	1	1872	12,900.00	12,900.00	.....
Herbarium.....	.....do.....	16	490	1	1872	4,700.00	4,700.00	.....
Library.....	.....do.....	16	490	1	1872	1,000.00	1,000.00	.....
	.....do.....	16	490	1	1872	1,000.00	1,000.00	.....
	.....do.....	16	490	1	1872	2,050.00	2,050.00	.....

*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of ap- propriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unex- pended.
		Vol.	Page.	Sec.				
Laboratory.....	Mar. 3, 1871	16	490	1	1872	\$3,450.00	\$3,450.00	.....
Salaries.....	May 8, 1872	17	77	1	1873	75,890.00	75,889.73	80.27
Collecting agricultural statis- tics.....	do.....	17	77	1	1873	15,000.00	15,000.00	.....
Purchase and distribution of seeds.....	do.....	17	77	1	1873	55,000.00	55,000.00	.....
Experimental garden and grounds.....	do.....	17	77	1	1873	31,000.00	31,000.00	.....
Contingent expenses.....	June 10, 1872	17	368	1	1873	13,300.00	12,507.06	792.94
Folding room.....	May 8, 1872	17	77	1	1873	300.00	300.00	.....
Furniture, cases, and repairs.....	do.....	17	78	1	1873	5,200.00	5,200.00	.....
Museum and herbarium.....	do.....	17	78	1	1873	5,000.00	4,674.43	325.57
Library.....	June 10, 1872	17	369	1	1873	1,750.00	1,750.00	.....
Salaries.....	May 8, 1872	17	78	1	1873	78,190.00	76,924.00	1,266.00
Collecting agricultural statis- tics.....	Mar. 3, 1873	17	506	1	1874	15,000.00	11,553.20	3,446.80
Purchase and distribution of seeds, etc.....	do.....	17	506	1	1874	65,000.00	64,904.89	95.11
Experimental garden and grounds.....	do.....	17	507	1	1874	26,200.00	25,731.74	468.26
Museum and herbarium.....	do.....	17	507	1	1874	2,000.00	1,942.02	57.98
Contingent expenses.....	do.....	17	507	1	1874	13,600.00	12,689.34	900.66
Furniture, cases, and repairs.....	do.....	17	507	1	1874	4,200.00	3,302.40	897.60
Library.....	do.....	17	507	1	1874	1,500.00	1,259.10	240.90
Postage.....	do.....	17	542	4	1874	52,000.00	35,449.09	16,550.91
Salaries.....	June 20, 1874	18	107	1	1875	77,180.00	77,127.60	52.40
Collecting agricultural statis- tics.....	do.....	18	107	1	1875	15,000.00	12,147.56	2,852.44
Purchase and distribution of seeds, etc.....	do.....	18	107	1	1875	95,000.00	94,719.83	280.17
Furniture, cases, and repairs.....	Jan. 25, 1875	18	303	3	1875	4,200.00	4,135.36	64.64
Experimental garden and grounds.....	June 20, 1874	18	107	1	1875	24,100.00	24,094.06	5.94
Contingent expenses.....	do.....	18	227	1	1875	12,600.00	10,972.61	1,627.39
Museum and herbarium.....	do.....	18	107	1	1875	4,500.00	3,300.00	1,020.00
Laboratory.....	June 23, 1874	18	227	1	1875	1,300.00	1,300.00	.....
Library.....	do.....	18	227	1	1875	1,500.00	1,087.90	412.10
Postage.....	do.....	18	227	1	1875	52,000.00	42,633.00	9,367.00
To publish Commissioner's re- port for the years 1872 and 1873.....	June 20, 1874	18	107	1	1875	50,000.00	49,561.91	438.09
Salaries.....	Mar. 3, 1875	18	368	1	1876	77,180.00	77,115.71	64.29
Collecting agricultural statis- tics.....	do.....	18	368	1	1876	15,000.00	14,500.00	500.00
Purchase and distribution of seeds.....	do.....	18	368	1	1876	65,000.00	65,000.00	.....
Experimental garden and grounds.....	do.....	18	368	1	1876	19,990.00	19,956.11	33.89
Museum and herbarium.....	do.....	18	394	1	1876	2,000.00	1,993.55	6.45
Furniture, cases, and repairs.....	do.....	18	368	1	1876	3,300.00	3,124.23	175.77
Library.....	do.....	18	368	1	1876	1,250.00	1,046.84	203.16
Laboratory.....	do.....	18	368	1	1876	1,300.00	1,300.00	.....
Contingent expenses.....	do.....	18	368	1	1876	12,100.00	11,378.91	721.09
Postage.....	do.....	18	368	1	1876	52,000.00	3,428.29	48,571.71
Salaries.....	do.....	19	95	1	1877	67,836.96	67,806.19	30.77
Experimental garden and grounds.....	July 21, 1876	19	167	1	1877	11,550.00	11,550.00	.....
Collecting agricultural statis- tics.....	Aug. 15, 1876	19	115	1	1877	10,000.00	10,000.00	.....
Purchase and distribution of seeds, etc.....	Mar. 3, 1877	19	319	1	1877	85,000.00	80,000.00	5,000.00
Museum and herbarium.....	do.....	19	167	1	1877	2,000.00	2,000.00	.....
Furniture, cases, and repairs.....	do.....	19	167	1	1877	2,000.00	2,000.00	.....
Library.....	do.....	19	167	1	1877	1,000.00	800.00	200.00
Laboratory.....	do.....	19	167	1	1877	1,300.00	1,300.00	.....
Contingent expenses.....	do.....	19	167	1	1877	10,000.00	8,800.00	1,200.00
Postage.....	do.....	19	167	1	1877	4,000.00	3,950.00	50.00
Salaries.....	Mar. 3, 1877	19	317	1	1878	65,640.00	65,640.00	.....
Collecting agricultural statis- tics.....	do.....	19	317	1	1878	15,000.00	15,000.00	.....
Purchase and distribution of seeds, etc.....	do.....	19	317	1	1878	75,000.00	74,579.33	420.67



*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Experimental garden and grounds.....	Mar. 3, 1877	19	317	1	1878	\$10,500.00	\$10,500.00	.....
Museum.....	do.	19	360	1				.....
Furniture, cases, and repairs.....	do.	19	317	1		1,500.00	1,500.00	.....
Library.....	do.	19	317	1		4,500.00	4,500.00	.....
Laboratory.....	do.	19	317	1		1,000.00	1,000.00	.....
Contingent expenses.....	do.	19	317	1		8,000.00	8,000.00	.....
Postage.....	do.	19	317	1		4,000.00	3,415.61	\$584.39
Report on forestry.....	do.	19	360	1	1878	2,500.00	2,500.00	.....
International Industrial Exposition at Paris.....	Dec. 15, 1877	20	246	4	1878	10,000.00	10,000.00	.....
Salaries.....	June 19, 1878	20	203	1	1879	66,900.00	66,900.00	.....
Collecting agricultural statistics.....	do.	20	203	1	1879	10,000.00	10,000.00	.....
Purchase and distribution of seeds, etc.....	do.	20	203	1	1879	75,000.00	75,000.00	.....
Experimental garden and grounds.....	do.	20	203	1	1879	13,500.00	13,500.00	.....
Museum.....	do.	20	240	1				.....
Furniture, cases, and repairs.....	do.	20	203	1		1,000.00	1,000.00	.....
Library.....	do.	20	204	1		4,000.00	4,000.00	.....
Laboratory.....	do.	20	204	1		1,000.00	1,000.00	.....
Contingent expenses.....	do.	20	204	1		1,500.00	1,500.00	.....
Postage.....	do.	20	204	1		8,000.00	8,000.00	.....
Investigating the history and habits of insects.....	do.	20	204	1	1879	4,000.00	3,960.00	40.00
Investigating diseases of domestic animals.....	do.	20	204	1	1879	10,000.00	10,000.00	.....
To erect a stable.....	Mar. 3, 1879	20	392	1	1879	1,500.00	1,500.00	.....
Collecting agricultural statistics.....	June 21, 1879	21	23	1	1880	66,900.00	66,900.00	.....
Purchase and distribution of seeds, etc.....	do.	21	23	1	1880	10,000.00	9,982.88	17.12
Experimental garden and grounds.....	do.	21	23	1	1880	75,000.00	75,000.00	.....
Museum.....	do.	21	23	1	1880	13,100.00	13,100.00	.....
Furniture, cases, and repairs.....	do.	21	23	1	1880	1,000.00	1,000.00	.....
Library.....	do.	21	23	1	1880	4,000.00	4,000.00	.....
Laboratory.....	do.	21	23	1	1880	1,000.00	1,000.00	.....
Contingent expenses.....	do.	21	23	1	1880	1,500.00	1,500.00	.....
Postage.....	do.	21	23	1	1880	8,000.00	8,000.00	.....
Investigating the history and habits of insects.....	do.	21	23	1	1880	4,000.00	4,000.00	.....
Investigating diseases of domestic animals.....	do.	21	29	1	1880	5,000.00	5,000.00	.....
Salaries.....	June 16, 1880	21	30	1	1880	10,000.00	8,878.84	1,121.16
Purchase and distribution of seeds, etc.....	do.	21	292	1	1881	69,200.00	69,185.22	14.78
Collecting agricultural statistics.....	May 21, 1881	21	294	1	1881	102,160.31	102,157.48	2.83
Experimental garden and grounds.....	do.	21	453	1				.....
Museum.....	June 16, 1880	21	293	1	1881	10,000.00	9,985.60	14.40
Furniture, cases, and repairs.....	do.	21	294	1	1881	12,600.00	12,600.00	.....
Library.....	do.	21	294	1	1881	1,000.00	1,000.00	.....
Laboratory.....	do.	21	294	1	1881	5,000.00	5,000.00	.....
Contingent expenses.....	do.	21	294	1	1881	1,000.00	1,000.00	.....
Postage.....	do.	21	295	1	1881	4,000.00	4,000.00	.....
Report on forestry.....	do.	21	295	1	1881	10,000.00	9,769.17	230.83
Investigating the history and habits of insects.....	do.	21	295	1	1881	4,000.00	3,838.00	162.00
Investigating diseases of domestic animals.....	do.	21	296	1	1881	5,000.00	3,762.51	1,237.49
Examination of fibers.....	do.	21	294	1	1881	5,000.00	4,997.31	2.69
Experiments in the manufacture of sugar.....	do.	21	295	1	1881	10,000.00	10,000.00	.....
Collecting data touching arid regions of the United States.....	do.	21	295	1	1881	4,000.00	4,000.00	.....
Reclamation of arid lands.....	do.	21	295	1	1881	7,500.00	7,500.00	.....
Salaries.....	Mar. 3, 1881	21	295	1	1881	5,000.00	460.00	4,540.00
Collecting agricultural statistics.....	do.	21	381	1	1882	20,000.00	18,353.55	(a)
Laboratory.....	do.	21	382	1	1882	79,500.00	79,491.81	8.19
.....	do.	21	382	1	1882	10,000.00	10,000.00	.....
.....	do.	21	382	1	1882	5,811.85	5,811.85	188.15

<sup>a</sup> Unexpended balance of \$1,646.45 carried to fiscal year 1882.

## Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Purchase and distribution of seeds, etc.	Mar. 3, 1881	21	382	1	1882	\$100,000.00	\$99,991.53	\$8.47
Experiments in the culture, etc., of tea.	Apr. 16, 1882	22	44	1				
Experimental garden and grounds.	Mar. 3, 1881	21	383	1	1882	10,000.00	8,750.87	1,249.13
Museum.	do.	21	383	1	1882	15,000.00	14,968.25	31.75
Furniture, cases, and repairs.	do.	21	385	1				
Library.	do.	21	383	1	1882	1,000.00	1,000.00	.....
Investigating the history and habits of insects.	do.	21	383	1	1882	4,000.00	4,000.00	.....
Examination of fibers.	do.	21	383	1	1882	1,000.00	973.85	26.15
Investigating the diseases of domestic animals.	do.	21	383	1	1882	20,000.00	19,998.94	1.06
Collecting data touching the arid regions of the United States.	do.	21	384	1	1882	5,000.00	5,000.00	.....
Reclamation of arid lands, including an unexpended balance of \$1,646.45 from fiscal year 1881.	do.	21	384	1	1882	25,000.00	22,443.89	2,556.11
Report on forestry.	do.	21	384	1	1882	5,000.00	4,216.55	783.45
Postage.	do.	21	384	1	1882	11,646.45	11,561.19	(a)
Contingent expenses.	do.	21	384	1	1882	5,000.00	4,941.00	59.00
Building for display of agricultural implements.	do.	21	384	1	1882	4,000.00	4,000.00	.....
Experiments in the manufacture of sugar (including \$864.60 from sale of molasses, etc.).	do.	21	385	1	1882	10,000.00	10,000.00	.....
Transportation of specimens from Atlanta.	do.	21	384	1	1882	35,864.60	32,333.75	(b)
Salaries.	Feb. 13, 1882	22	3	1	1882	5,000.00	4,998.91	1.09
Collecting agricultural statistics.	May 19, 1882	22	89	1	1883	102,580.00	102,575.49	4.51
Laboratory.	do.	22	90	1	1883	80,000.00	78,170.80	1,829.20
Purchase and distribution of seeds, etc.	do.	22	90	1	1883	6,000.00	6,000.00	.....
Experiments in the culture, etc., of tea.	do.	22	90	1	1883	80,000.00	80,000.00	.....
Experimental garden and grounds.	do.	22	91	1	1883	5,000.00	3,905.66	1,094.34
Museum.	do.	22	91	1				
Furniture, cases, and repairs.	do.	22	92	1	1883	15,500.00	15,471.82	28.18
Library.	do.	22	91	1	1883	1,000.00	1,000.00	.....
Investigating the history and habits of insects.	do.	22	91	1	1883	6,700.00	6,700.00	.....
Examination of fibers.	do.	22	91	1	1883	1,500.00	1,485.32	14.68
Investigating the diseases of domestic animals.	do.	22	91	1	1883	20,000.00	19,997.75	2.25
Reclamation of arid lands, including an unexpended balance of \$85.26 from fiscal year 1882.	do.	22	91	1	1883	10,000.00	7,961.94	2,038.06
Report on forestry.	do.	22	92	1	1883	25,000.00	21,584.28	3,415.72
Postage.	do.	22	92	1	1883	20,085.26	12,429.13	(c)
Contingent expenses.	do.	22	92	1	1883	10,000.00	8,731.99	1,268.01
Experiments in the manufacture of sugar, including an unexpended balance of \$3,530.85 from fiscal year 1882.	do.	22	92	1	1883	4,000.00	3,977.49	22.51
Erection of building for seed division.	do.	22	92	1	1883	15,000.00	14,920.74	79.26
Report on the Angora goat.	Aug. 7, 1882	22	306	1	1883	28,530.85	28,529.31	1.54
Salaries.	do.	22	337	1	1883	25,000.00	25,000.00	.....
Collecting agricultural statistics.	Jan. 20, 1883	22	408	1	1884	500.00	500.00	.....
Laboratory, and for experiments in the manufacture of sugar, including \$842.18 from the sale of sirup, etc.	do.	22	410	1	1884	127,640.00	127,639.87	.13
	do.	22	410	1	1884	80,000.00	79,770.86	229.14
	do.	22	410	1	1884	16,842.18	16,829.26	12.92

(a) Unexpended balance of \$85.26 carried to fiscal year 1883.

(b) Unexpended balance of \$3,530.85 carried to fiscal year 1883.

(c) Unexpended balance of \$7,656.13 carried to fiscal year 1884.

*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Purchase and distribution of seeds, etc.	Jan. 20, 1883	22	410	1	1884	\$75,000.00	\$74,986.48	\$13.52
Experimental gardens and grounds	do	22	409	1	1884	15,500.00	15,448.87	51.13
Museum	do	22	411	1	1884	1,000.00	998.51	6.49
Furniture, cases, and repairs	do	22	409	1	1884	6,000.00	5,998.82	1.18
Library	do	22	411	1	1884	1,500.00	1,439.86	60.14
Investigating the history and habits of insects	do	22	409	1	1884	20,002.82	20,002.82	.....
Reclamation of arid lands, including an unexpended balance of \$7,656.13 from fiscal year 1883	Aug. 4, 1886	24	273	1				
Investigating the diseases of domestic animals	Jan. 20, 1883	22	411	1	1884	17,656.13	16,164.68	1,491.45
Report on forestry	do	22	411	1	1884	25,000.00	24,011.85	988.15
Postage	do	22	411	1	1884	10,000.00	9,998.30	1.70
Contingent expenses	do	22	411	1	1884	4,000.00	3,841.48	158.52
Building of greenhouse	do	22	411	1	1884	14,000.00	13,991.43	8.57
Salaries	do	22	631	1	1884	2,500.00	2,500.00	.....
Collecting agricultural statistics	June 5, 1884	23	36	1	1885	137,590.00	137,557.80	32.20
Bureau of Animal Industry	do	23	38	1	1885	100,000.00	99,986.59	13.41
Purchase and distribution of seeds, etc.	May 29, 1884	23	31	1	1885	150,000.00	56,807.73	(a)
Laboratory, and for experiments in the manufacture of sugar	June 5, 1884	23	38	1	1885	100,000.00	99,983.82	16.18
Investigating the history and habits of insects	do	23	38	1	1885	50,000.00	49,996.70	3.30
Silk culture	do	23	37	1	1885	20,000.00	19,986.83	13.17
Contingent expenses	do	23	39	1	1885	15,000.00	14,916.23	83.77
Report on forestry	do	23	39	1	1885	15,000.00	14,862.20	137.80
Experimental garden and grounds	do	23	39	1	1885	10,000.00	9,987.36	12.64
Furniture, cases, and repairs	do	23	37	1	1885	17,840.25	17,513.67	326.58
Postage	Oct. 19, 1888	25	581	1				
Experiments in the culture, etc., of tea	June 5, 1884	23	38	1	1885	6,000.00	5,947.27	52.73
Library	do	23	39	1	1885	4,000.00	3,956.98	43.02
Museum	do	23	39	1	1885	3,000.00	2,998.90	1.10
Quarantine stations	do	23	39	1	1885	1,500.00	1,403.63	96.37
Salaries	do	23	37	1	1885	1,000.00	1,000.00	.....
Collecting agricultural statistics	June 7, 1884	23	207	1	1885	25,000.00	22,029.18	(b)
Bureau of Animal Industry, including an unexpended balance of \$93,192.27 from fiscal year 1885	Mar. 3, 1885	23	353	1	1886	137,590.00	137,337.42	252.58
Quarantine stations, including an unexpended balance of \$2,970.82 for fiscal year 1885	do	23	355	1	1886	75,000.00	68,723.06	6,276.94
Purchase and distribution of seeds, etc.	do	23	355	1	1886	193,192.27	58,261.05	134,931.22
Laboratory, and for experiments in the manufacture of sugar	do	23	356	1	1886	32,970.82	18,958.57	14,012.25
Investigating the history and habits of insects	do	23	354	1	1886	100,000.00	99,980.24	19.76
Silk culture	do	23	354	1	1886	40,000.00	39,942.11	57.89
Contingent expenses	do	23	354	1	1886	25,000.00	24,976.46	23.54
Report on forestry	do	23	356	1	1886	15,012.00	15,008.50	3.50
Experimental garden and grounds	do	23	356	1	1886	15,000.00	14,937.62	62.38
Furniture, cases, and repairs	do	23	356	1	1886	10,000.00	9,836.83	163.17
Postage	do	23	254	1				
Experiments in the culture, etc., of tea	Aug. 4, 1886	24	273	1	1886	17,208.13	17,024.88	183.25
Library	Oct. 19, 1888	25	581	1				
Museum	Mar. 3, 1885	23	354	1	1886	7,500.00	7,423.59	76.41
Quarantine stations	do	23	356	1	1886	4,000.00	2,556.20	1,443.80
Salaries	do	23	356	1	1886	3,000.00	1,813.67	1,186.33
Collecting agricultural statistics	do	23	355	1	1886	1,500.00	1,417.03	82.97
Bureau of Animal Industry	do	23	354	1	1886	1,000.00	998.88	1.12
Quarantine stations	do	23	354	1	1886	1,000.00	1,000.00	.....
Purchase and distribution of seeds, etc.	June 30, 1886	24	100	1	1887	142,890.00	141,420.68	1,469.32

a Unexpended balance of \$93,192.27 carried to fiscal year 1886.

b Unexpended balance of \$2,970.82 carried to fiscal year 1886.



*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collecting agricultural statistics.....	June 30, 1886	24	103	1	1887	\$65,000.00	\$64,955.14	\$44.86
Bureau of Animal Industry.....	do.	24	103	1	1887	100,000.00	99,985.56	14.44
Quarantine stations.....	do.	24	103	1	1887	30,000.00	10,639.44	19,360.56
Purchase and distribution of seeds, etc.....	do.	24	102	1	1887	100,000.00	99,998.37	1.63
Laboratory.....	do.	24	101	1	1887	6,000.00	4,570.86	1,429.14
Experiments in the manufacture of sugar, including \$1,891 from sales.....	do.	24	101	1	1887	95,891.00	95,853.14	37.86
Investigating the history and habits of insects.....	do.	24	101	1	1887	15,096.25	15,088.05	8.20
Silk culture, including \$864.81 from sale of raw silk.....	Oct. 19, 1888	25	582	1	1887	15,939.56	15,939.56	.....
Contingent expenses.....	June 30, 1886	24	104	1	1887	15,000.00	14,936.83	63.17
Report on forestry.....	do.	24	103	1	1887	8,000.00	7,953.50	46.50
Experimental garden and grounds.....	do.	24	102	1	1887	23,200.00	22,202.15	997.85
Furniture, cases, and repairs.....	do.	24	103	1	1887	8,125.00	8,092.11	32.89
Postage.....	do.	24	104	1	1887	4,000.00	3,500.00	500.00
Experiments in the culture, etc., of tea.....	do.	24	104	1	1887	2,000.00	1,753.78	246.22
Pomological information.....	do.	24	100	1	1887	3,000.00	2,993.20	6.80
Library.....	do.	24	103	1	1887	1,500.00	1,428.65	71.35
Botanical investigations.....	do.	24	100	1	1887	5,000.00	4,988.12	11.88
Museum.....	do.	24	102	1	1887	1,000.00	998.88	1.12
Ornithology and mammalogy.....	do.	24	101	1	1887	10,000.00	9,999.98	.02
Reclamation of arid lands.....	do.	24	103	1	1887	5,000.00	.....	5,000.00
Adulteration of food.....	do.	24	100	1	1887	1,000.00	999.14	10.86
Salaries.....	Mar. 3, 1887	24	495	1	1888	161,490.00	158,220.87	3,269.13
Collecting agricultural statistics.....	do.	24	498	1	1888	65,000.00	64,965.33	34.67
Bureau of Animal Industry, including \$100,000 immediately available.....	do.	24	499	1	1888	500,000.00	499,975.32	24.68
Quarantine stations.....	do.	24	499	1	1888	20,000.00	9,538.75	10,461.25
Purchase and distribution of seeds, etc.....	do.	24	498	1	1888	103,000.00	102,587.55	412.45
Laboratory.....	do.	24	497	1	1888	6,000.00	5,969.89	30.11
Experiments in the manufacture of sugar.....	do.	24	497	1	1888	50,000.00	49,997.43	2.57
Experiments in the manufacture of sugar (deficiency).....	Oct. 19, 1888	25	582	1	1887 } 1888 }	8,000.00	7,927.50	72.50
Investigating the history and habits of insects.....	Mar. 3, 1887	24	497	1	1888	20,000.00	20,000.00	.....
Silk culture, including \$1,989.06 from sale of raw silk.....	do.	24	497	1	1888	16,989.06	16,989.02	.04
Contingent expenses.....	do.	24	499	1	1888	15,000.00	14,825.57	174.43
Report on forestry.....	do.	24	499	1	1888	8,000.00	7,996.10	3.90
Experimental garden and grounds.....	do.	24	497	1	1888	24,800.00	24,706.86	93.14
Furniture, cases, and repairs.....	do.	24	498	1	1888	7,000.00	6,982.88	17.12
Postage.....	do.	24	499	1	1888	4,000.00	3,000.00	1,000.00
Pomological information.....	do.	24	497	1	1888	3,000.00	2,971.69	28.31
Library.....	do.	24	499	1	1888	2,000.00	1,983.78	16.22
Botanical investigations.....	do.	24	496	1	1888	7,000.00	6,997.28	2.72
Museum.....	do.	24	497	1	1888	1,000.00	947.41	52.59
Ornithology and mammalogy.....	do.	24	497	1	1888	3,940.00	3,869.23	70.77
Adulteration of food.....	do.	24	497	1	1888	1,000.00	830.16	169.84
Salaries.....	July 18, 1888	25	328	1	1889	171,890.32	169,152.51	2,737.81
Collecting agricultural statistics.....	Mar. 2, 1889	25	923	1	1889	70,000.00	69,162.45	837.55
Botanical investigations.....	do.	25	330	1	1889	35,000.00	22,076.75	(a)
Investigating the history and habits of insects.....	do.	25	331	1	1889	20,131.64	20,131.64	.....
Ornithology and mammalogy.....	Sept. 30, 1890	26	525	1	1889	5,025.90	5,022.06	3.84
Pomological information.....	July 18, 1888	25	332	1	1889	4,024.48	4,020.32	4.16
Microscopical investigations.....	do.	25	330	1	1889	1,000.00	999.87	.13
Laboratory.....	do.	25	330	1	1889	11,000.00	9,994.25	1,005.75
	Mar. 2, 1889	25	837	1	1889			

<sup>a</sup> Unexpended balance of \$12,923.25 carried to fiscal year 1890.

*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forestry investigations.....	July 18, 1888	25	333	1	1889	\$8,000.00	\$7,999.03	\$0.97
Purchase and distribution of seeds.....	.....do.....	25	332	1	1889	104,200.00	104,168.73	31.27
Experimental gardens and grounds.....	.....do.....	25	332	1	1889	26,640.00	26,639.83	.17
Museum.....	.....do.....	25	332	1	1889	1,000.00	891.25	108.75
Furniture, cases, and repairs..	.....do.....	25	333	1	1889	7,350.00	7,236.74	113.26
Library.....	.....do.....	25	333	1	1889	2,000.00	1,956.34	43.66
Postage.....	.....do.....	25	333	1	1889	4,000.00	4,000.00	.....
Contingent expenses.....	.....do.....	25	333	1	1889	15,010.00	15,009.22	.78
Office of Experiment Stations.	Mar. 3, 1891	26	881	1	1889	10,000.00	9,033.77	966.23
Experiments in the manufacture of sugar.....	July 18, 1888	25	334	1	1889	100,000.00	41,635.24	(a)
Quarantine stations.....	.....do.....	25	333	1	1889	15,000.00	11,628.39	3,371.61
Bureau of Animal Industry..	.....do.....	25	333	1	1889	500,000.00	479,023.57	20,376.43
Silk culture, including \$708.26 from sale of raw silk.....	.....do.....	25	331	1	1889	23,208.26	23,208.26	.....
Salaries.....	Mar. 2, 1889	25	835	1	1890	178,580.00	175,547.04	3,032.96
Collecting agricultural statistics.....	.....do.....	25	839	1	1890	75,000.00	74,327.51	672.49
Botanical investigations, including an unexpended balance of \$12,923.25 from fiscal year 1889.....	.....do.....	25	836	1	1890	48,009.25	47,990.38	18.87
Investigating the history and habits of insects.....	July 28, 1892	27	296	1	1890	20,000.00	19,892.72	107.28
Ornithology and mammalogy..	.....do.....	25	838	1	1890	7,000.00	6,994.16	5.84
Pomological information.....	July 14, 1890	26	285	1	1890	4,304.79	4,304.79	.....
Microscopical investigations..	Mar. 2, 1889	25	837	1	1890	1,062.50	1,062.50	.....
Laboratory.....	Mar. 3, 1891	26	881	1	1890	6,000.00	5,461.99	538.01
Forestry investigations.....	Mar. 2, 1889	25	837	1	1890	8,000.00	7,999.96	.04
Purchase and distribution of seeds.....	.....do.....	25	839	1	1890	104,200.00	104,174.55	25.45
Experimental garden and grounds.....	.....do.....	25	838	1	1890	26,640.00	26,478.45	161.55
Museum.....	.....do.....	25	838	1	1890	1,000.00	998.39	1.61
Furniture, cases, and repairs..	.....do.....	25	839	1	1890	9,350.00	9,261.93	88.07
Library.....	Apr. 4, 1890	26	42	1	1890	2,000.00	1,738.28	261.72
Postage.....	Mar. 2, 1889	25	839	1	1890	4,000.00	4,000.00	.....
Contingent expenses.....	.....do.....	25	840	1	1890	20,000.00	19,965.32	34.68
Office of Experiment Stations.	Apr. 4, 1890	26	42	1	1890	15,000.00	14,991.69	8.31
Experiments in the manufacture of sugar, including an unexpended balance of \$58,364.76 from fiscal year 1889.....	Mar. 2, 1889	25	840	1	1890	83,364.76	83,064.14	300.62
Quarantine stations.....	.....do.....	25	840	1	1890	15,000.00	11,266.24	3,733.76
Bureau of Animal Industry..	.....do.....	25	839	1	1890	500,000.00	311,025.31	(b)
Silk culture, including \$1,627.81 from sale of raw silk.....	.....do.....	25	837	1	1890	21,627.81	21,626.10	1.71
Artesian wells.....	.....do.....	25	837	1	1890	20,000.00	19,652.17	347.83
Salaries.....	Apr. 4, 1890	26	42	1	1891	248,902.85	239,923.29	8,979.56
Collecting agricultural statistics.....	July 14, 1890	26	282	1	1891	100,000.00	85,126.44	14,873.56
Botanical investigations.....	.....do.....	26	284	1	1891	40,000.00	36,428.36	3,571.64
Investigating the history and habits of insects.....	.....do.....	26	285	1	1891	27,501.77	27,481.00	20.77
Ornithology and mammalogy..	July 28, 1892	27	296	1	1891	14,004.90	13,003.67	1,001.23
Pomological information.....	July 14, 1890	26	285	1	1891	5,000.00	4,983.88	16.12
Microscopical investigations..	.....do.....	26	285	1	1891	15,000.00	14,995.75	4.25
Vegetable pathology.....	.....do.....	26	285	1	1891	20,200.00	19,985.27	214.73
Laboratory.....	.....do.....	26	286	1	1891	10,000.00	9,785.99	214.01
Forestry investigations.....	.....do.....	26	286	1	1891	2,000.00	1,999.58	.42
Illustrations and engravings..	.....do.....	26	286	1	1891	105,400.00	105,090.94	309.06
Purchase and distribution of seeds.....	.....do.....	26	286	1	1891	105,400.00	105,090.94	309.06

a Unexpended balance of \$58,364.76 carried to fiscal year 1890.

b Unexpended balance of \$188,974.69 carried to fiscal year 1891.

*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Document and folding room.....	July 14, 1890	26	287	1	1891	\$2,000.00	\$1,995.53	\$4.47
Experimental garden and grounds.....	do.....	26	287	1	1891	28,500.00	28,396.41	103.59
Museum.....	do.....	26	287	1	1891	4,000.00	3,832.28	167.72
Furniture, cases, and repairs.....	do.....	26	287	1	1891	12,000.00	11,991.01	8.99
Library.....	Mar. 3, 1891	26	1049	1	1891	3,000.00	2,997.20	2.80
Postage.....	July 14, 1890	26	287	1	1891	5,000.00	4,833.00	167.00
Contingent expenses.....	do.....	26	287	1	1891	20,000.00	18,097.13	1,902.87
Office of Experiment Stations.....	do.....	26	288	1	1891	15,000.00	14,984.48	15.52
Experiments in the manufacture of sugar.....	do.....	26	288	1	1891	75,000.00	74,901.18	98.82
Irrigation investigations.....	Mar. 3, 1891	26	1050	1	1891	40,000.00	39,926.67	73.33
Quarantine stations.....	Sept. 30, 1890	26	525	1	1891	15,000.00	13,586.72	1,413.28
Bureau of Animal Industry, including an unexpended balance of \$188,974.69 from fiscal year 1890.....	July 14, 1890	26	288	1	1891	538,974.69	469,113.35	69,861.34
Silk culture, including \$565 from sale of raw silk.....	do.....	26	285	1	1891	20,565.00	19,536.33	1,028.67
Salaries.....	Mar. 3, 1891	26	1045	1	1892	256,800.00	252,766.17	4,033.83
Collecting agricultural statistics.....	do.....	26	1046	1	1892	102,500.00	88,869.51	13,630.49
Botanical investigations.....	do.....	26	1046	1	1892	40,246.40	40,246.40	.....
Investigating the history and habits of insects.....	Aug. 23, 1894	28	440	1	1892	27,800.00	27,780.03	19.97
Ornithology and mammalogy.....	do.....	26	1047	1	1892	15,000.00	14,688.00	312.00
Pomological information.....	do.....	26	1047	1	1892	5,000.00	4,985.27	14.73
Microscopical investigations.....	do.....	26	1047	1	1892	2,000.00	1,251.46	748.54
Vegetable pathology.....	do.....	26	1047	1	1892	15,076.47	15,076.47	.....
Laboratory.....	Aug. 23, 1894	28	440	1	1892	19,400.00	19,272.59	127.41
Fiber investigations.....	Mar. 3, 1891	26	1048	1	1892	10,000.00	8,017.44	1,982.56
Forestry investigations.....	do.....	26	1048	1	1892	15,056.85	15,056.85	.....
Illustrations and engravings.....	Mar. 3, 1893	27	660	1	1892	2,000.00	1,999.85	.15
Purchase and distribution of seeds.....	Mar. 3, 1891	26	1048	1	1892	105,400.00	104,920.35	479.65
Document and folding room.....	do.....	26	1049	1	1892	2,000.00	1,996.82	3.18
Experimental garden and grounds.....	do.....	26	1049	1	1892	28,622.53	28,536.67	85.86
Museum.....	Mar. 3, 1893	27	660	1	1892	4,000.00	3,909.17	90.83
Furniture, cases, and repairs.....	Mar. 3, 1891	26	1049	1	1892	10,000.00	9,996.55	3.45
Library.....	do.....	26	1049	1	1892	3,000.00	2,807.75	192.25
Postage.....	do.....	26	1049	1	1892	5,000.00	4,900.00	100.00
Contingent expenses.....	do.....	26	1049	1	1892	25,000.00	24,762.32	237.68
Office of Experiment Stations.....	do.....	26	1050	1	1892	20,000.00	19,989.47	10.53
Experiments in the manufacture of sugar.....	do.....	26	1050	1	1892	35,000.00	34,627.78	372.22
Quarantine stations.....	Mar. 18, 1892	27	7	1	1892	15,000.00	14,983.63	16.37
Bureau of Animal Industry.....	Mar. 3, 1891	26	1045	1	1892	650,000.00	649,980.91	19.09
Weather Bureau.....	Mar. 18, 1892	27	7	1	1892	889,753.50	861,840.83	27,912.67
Salaries.....	Mar. 3, 1891	26	1051	1	1893	256,800.00	253,896.30	2,903.70
Collecting agricultural statistics.....	July 5, 1892	27	74	1	1893	110,000.00	95,649.21	14,350.79
Botanical investigations and experiments.....	do.....	27	76	1	1893	27,500.00	27,451.55	48.45
Investigating the history and habits of insects.....	do.....	27	77	1	1893	17,800.00	17,290.80	509.20
Investigations in ornithology and mammalogy.....	do.....	27	77	1	1893	15,000.00	14,947.77	52.23
Pomological information.....	do.....	27	77	1	1893	5,000.00	4,745.94	254.06
Microscopical investigations.....	do.....	27	77	1	1893	2,000.00	1,982.98	17.02
Vegetable pathology.....	do.....	27	77	1	1893	20,000.00	19,977.38	22.62
Laboratory.....	do.....	27	77	1	1893	19,400.00	18,002.59	1,397.41
Fiber investigations.....	do.....	27	78	1	1893	5,000.00	4,997.07	2.93
Forest investigations.....	do.....	27	78	1	1893	12,000.00	11,933.39	66.61
Illustrations and engravings.....	do.....	27	78	1	1893	2,000.00	1,906.73	93.27
Purchase and distribution of seeds.....	do.....	27	78	1	1893	135,400.00	134,908.27	491.73
Document and folding room.....	do.....	27	78	1	1893	2,000.00	1,623.55	376.45
Experimental garden and grounds.....	do.....	27	78	1	1893	28,500.00	28,115.09	384.91
Museum.....	do.....	27	79	1	1893	4,000.00	3,973.67	26.33



*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Furniture, cases, and repairs ..	July 5, 1892	27	79	1	1893	\$10,000.00	\$8,931.97	\$1,068.03
Library .....	.....do.....	27	79	1	1893	3,000.00	2,535.29	464.71
Postage .....	.....do.....	27	79	1	1893	5,000.00	3,705.00	1,295.00
Contingent expenses .....	.....do.....	27	79	1	1893	25,000.00	22,218.19	2,781.81
Experiment stations .....	.....do.....	27	80	1	1893	20,000.00	18,987.65	1,012.35
Experiments in the manufac- ture of sugar .....	.....do.....	27	80	1	1893	20,000.00	19,984.86	15.14
Irrigation investigations .....	.....do.....	27	76	1	1893	6,000.00	4,930.67	1,069.33
Quarantine stations .....	.....do.....	27	80	1	1893	15,000.00	12,633.23	2,366.77
Experiments in the production of rainfall .....	.....do.....	27	76	1	1893	10,000.00	4,979.59	5,020.41
Bureau of Animal Industry .....	.....do.....	27	79	1	1893	850,000.00	724,696.74	125,303.26
Weather Bureau .....	.....do.....	27	81	1	1893	913,660.72	890,424.77	23,235.95
Salaries .....	Mar. 3, 1893	27	734	1	1894	256,800.00	233,679.75	23,120.25
Collecting agricultural statis- tics .....	.....do.....	27	736 737	1	1894	110,000.00	91,080.20	18,919.80
Botanical investigations and experiments .....	.....do.....	27	737	1	1894	30,000.00	24,401.40	5,598.60
Investigating the history and habits of insects .....	.....do.....	27	737	1	1894	20,300.00	16,203.96	4,096.04
Investigations in ornithology and mammalogy .....	.....do.....	27	737	1	1894	17,500.00	17,450.00	50.00
Pomological information .....	.....do.....	27	738	1	1894	5,000.00	4,248.99	751.01
Microscopical investigations .....	.....do.....	27	738	1	1894	2,000.00	1,117.55	882.45
Vegetable pathology .....	.....do.....	27	738	1	1894	20,000.00	17,576.95	2,423.05
Laboratory .....	.....do.....	27	738	1	1894	21,900.00	10,426.79	11,473.21
Fiber investigations .....	.....do.....	27	738	1	1894	5,000.00	2,500.47	2,499.53
Forestry investigations .....	.....do.....	27	738	1	1894	20,000.00	19,995.96	4.04
Illustrations and engravings .....	.....do.....	27	738	1	1894	2,000.00	664.79	1,335.21
Purchase and distribution of seeds .....	.....do.....	27	738	1	1894	135,400.00	119,719.76	15,680.24
Document and folding room .....	.....do.....	27	739	1	1894	2,000.00	1,662.81	337.19
Experimental garden and grounds .....	.....do.....	27	739	1	1894	31,500.00	26,616.86	4,883.14
Museum .....	.....do.....	27	739	1	1894	4,000.00	2,787.22	1,212.78
Furniture, cases, and repairs ..	.....do.....	27	739	1	1894	10,000.00	8,628.76	1,371.24
Library .....	.....do.....	27	739	1	1894	3,000.00	2,900.07	99.93
Postage .....	.....do.....	27	740	1	1894	5,000.00	1,375.00	3,625.00
Contingent expenses .....	.....do.....	27	740	1	1894	25,000.00	20,493.04	4,506.96
Experiment stations .....	.....do.....	27	740	1	1894	25,223.50	22,381.85	2,841.65
Inquiries relating to public roads .....	.....do.....	27	737	1	1894	10,000.00	2,997.39	7,002.61
Experiments in the manufac- ture of sugar .....	.....do.....	27	741	1	1894	20,107.33	9,451.80	10,655.53
Irrigation investigations .....	.....do.....	27	741	1	1894	6,000.00	5,475.92	524.08
Quarantine stations .....	.....do.....	27	740	1	1894	15,000.00	6,263.92	8,736.08
Bureau of Animal Industry .....	.....do.....	27	740	1	1894	850,000.00	496,111.34	353,888.66
Weather Bureau .....	.....do.....	27	741	1	1894	951,124.75	811,256.73	139,868.02
Salaries .....	Aug. 18, 1894	28	266	1	1895	249,876.16	204,589.72	45,286.44
Collecting agricultural statis- tics .....	.....do.....	28	266	1	1895	110,000.00	95,125.67	14,874.33
Botanical investigations and experiments .....	.....do.....	28	267	1	1895	30,000.00	25,695.30	4,304.70
Investigating the history and habits of insects .....	.....do.....	28	267	1	1895	20,300.00	16,822.87	3,477.13
Investigations in ornithology, etc. ....	.....do.....	28	267	1	1895	17,500.00	15,526.35	1,973.65
Pomological information .....	.....do.....	28	267	1	1895	5,000.00	4,920.23	79.77
Microscopical investigations .....	.....do.....	28	267	1	1895	2,000.00	313.87	1,686.13
Vegetable pathological investi- gations, etc. ....	.....do.....	28	267	1	1895	20,000.00	19,063.09	936.31
Laboratory .....	.....do.....	28	267	1	1895	14,900.00	11,010.50	3,889.50
Fiber investigations .....	.....do.....	28	271	1	1895	5,000.00	3,973.81	1,026.19
Report on forestry .....	.....do.....	28	268	1	1895	20,000.00	19,908.23	91.77
Illustrations and engravings .....	.....do.....	28	268	1	1895	15,000.00	9,114.71	5,885.29
Purchase and distribution of valuable seeds .....	.....do.....	28	269	1	1895	165,400.00	120,545.15	44,854.85
Document and folding room .....	.....do.....	28	268	1	1895	2,000.00	1,166.83	833.17
Experimental gardens and grounds .....	.....do.....	28	268	1	1895	29,500.00	23,578.11	5,921.89
Museum .....	.....do.....	28	271	1	1895	3,000.00	1,889.73	1,110.27
Furniture, cases, and repairs ..	.....do.....	28	271	1	1895	10,000.00	7,952.27	2,047.73
Library .....	.....do.....	28	272	1	1895	6,000.00	5,963.20	36.80
Postage .....	.....do.....	28	271	1	1895	5,000.00	765.00	4,235.00
Nutrition investigations .....	.....do.....	28	271	1	1895	10,000.00	9,746.30	253.70
Contingent expenses .....	.....do.....	28	272	1	1895	25,000.00	20,452.79	4,547.21

*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Agricultural experiment stations.....	Aug. 18, 1894	28	271	1	1895	\$25,000.00	\$24,928.22	\$71.78
Inquiries relating to public roads.....	do.....	28	266	1	1895	10,000.00	6,901.66	3,098.34
Experiments in the manufacture of sugar.....	do.....	28	271	1	1895	10,000.00	6,188.80	3,811.20
Irrigation investigations.....	do.....	28	271	1	1895	6,000.00	3,904.88	2,095.12
Quarantine stations for neat cattle.....	do.....	28	269	1	1895	12,000.00	6,262.17	5,737.83
Bureau of Animal Industry.....	do.....	28	269	1	1895	800,000.00	534,028.38	265,971.62
Weather Bureau.....	do.....	28	272	1	1895	878,438.84	820,691.94	57,746.90
Salaries.....	Mar. 2, 1895	28	727	1	1896	252,840.00	217,066.97	35,773.03
Collecting agricultural statistics.....	do.....	28	729	1	1896	110,000.00	68,628.99	41,371.01
Inquiries relating to public roads.....	do.....	28	729	1	1896	10,000.00	9,568.39	431.61
Botanical investigations and experiments.....	do.....	28	730	1	1896	25,000.00	20,325.37	4,674.63
Investigating the history and habits of insects.....	do.....	28	730	1	1896	20,000.00	17,372.43	2,627.57
Investigations in ornithology and mammalogy.....	do.....	28	730	1	1896	17,500.00	16,175.45	1,324.55
Pomological information.....	do.....	28	730	1	1896	6,000.00	4,996.41	1,003.59
Microscopical investigations.....	do.....	28	730	1	1896	2,000.00	.....	2,000.00
Vegetable pathological investigations and experiments.....	do.....	28	730	1	1896	20,000.00	18,539.18	1,460.82
Laboratory.....	do.....	28	730	1	1896	14,900.00	11,458.53	3,441.47
Report on forestry.....	do.....	28	731	1	1896	25,000.00	18,398.12	6,601.88
Illustrations and engravings.....	do.....	28	731	1	1896	15,000.00	12,985.71	2,014.29
Document and folding room.....	do.....	28	731	1	1896	2,000.00	1,061.23	938.77
Experimental gardens and grounds.....	do.....	28	731	1	1896	29,500.00	22,371.15	7,128.85
Quarantine stations for neat cattle.....	do.....	28	733	1	1896	12,000.00	6,492.05	5,507.95
Purchase and distribution of valuable seeds.....	do.....	28	733	1	1896	185,400.00	126,476.87	58,923.13
Experiments in the manufacture of sugar.....	do.....	28	734	1	1896	10,000.00	1,510.94	8,489.06
Agricultural experiment stations (\$750,000 <sup>a</sup> ).....	do.....	28	734	1	1896	<sup>b</sup> 30,143.75	27,712.86	2,430.89
Irrigation investigations.....	do.....	28	735	1	1896	15,000.00	5,029.82	9,970.18
Nutrition investigations.....	do.....	28	735	1	1896	15,000.00	14,892.96	107.04
Investigations and experiments with grasses and forage plants.....	do.....	28	735	1	1896	15,000.00	13,329.47	1,670.53
Investigations in relation to agricultural soils.....	do.....	28	735	1	1896	15,000.00	13,524.84	1,475.16
Furniture, cases, and repairs.....	do.....	28	735	1	1896	10,000.00	8,645.98	1,354.02
Postage.....	do.....	28	735	1	1896	2,000.00	1,215.00	785.00
Museum.....	do.....	28	735	1	1896	3,000.00	2,161.90	838.10
Fiber investigations.....	do.....	28	735	1	1896	5,000.00	3,710.36	1,289.64
Library.....	do.....	28	735	1	1896	6,000.00	5,431.92	568.08
Contingent expenses.....	do.....	28	736	1	1896	25,000.00	15,912.71	9,087.29
Bureau of Animal Industry.....	do.....	28	731	1	1896	800,000.00	595,336.64	204,663.36
Weather Bureau.....	do.....	28	736	1	1896	<sup>c</sup> 885,729.47	814,584.17	71,145.30
Salaries.....	Apr. 25, 1896	29	99	1	1897	313,860.00	290,791.95	23,068.05
Furniture, cases, and repairs.....	do.....	29	105	1	1897	12,000.00	9,567.59	2,432.41
Library.....	do.....	29	104	1	1897	7,000.00	6,831.15	168.85
Museum.....	do.....	29	105	1	1897	3,000.00	2,895.45	104.55
Postage.....	do.....	29	105	1	1897	3,000.00	1,730.00	1,270.00
Contingent expenses.....	do.....	29	105	1	1897	25,000.00	22,980.29	2,019.71
Animal quarantine stations.....	do.....	29	105	1	1897	12,000.00	6,564.19	5,435.81
Collecting agricultural statistics.....	do.....	29	101	1	1897	110,000.00	83,067.62	26,932.38
Botanical investigations and experiments.....	do.....	29	101	1	1897	15,000.00	14,999.64	.36
Entomological investigations.....	do.....	29	102	1	1897	20,000.00	18,637.01	1,362.99
Vegetable pathological investigations.....	do.....	29	102	1	1897	20,000.00	19,274.15	725.85
Biological investigations.....	do.....	29	102	1	1897	17,500.00	17,433.05	16.95
Pomological investigations.....	do.....	29	102	1	1897	6,000.00	4,981.52	1,018.48

<sup>a</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

<sup>b</sup> Includes \$143.75 from the sale of card index.

<sup>c</sup> Includes \$119.47 from the sale of Weather Bureau publications.

*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Laboratory.....	Apr. 25, 1896	29	102	1	1897	\$12,400.00	\$10,800.18	\$1,599.82
Forestry investigations.....	.....do.....	29	103	1	1897	20,000.00	19,514.88	485.12
Experimental gardens and grounds.....	.....do.....	29	103	1	1897	20,000.00	19,483.28	516.72
Soil investigations.....	.....do.....	29	103	1	1897	10,000.00	9,868.16	131.84
Grass and forage plant investigations.....	.....do.....	29	103	1	1837	10,000.00	9,203.14	796.86
Fiber investigations.....	.....do.....	29	103	1	1897	5,000.00	4,143.00	857.00
Agricultural experiment stations (\$750,000 <sup>a</sup> ).....	.....do.....	29	103	1	1897	b 30,127.25	29,171.57	955.68
Nutrition investigations.....	.....do.....	29	104	1	1897	15,000.00	14,821.64	178.36
Public road inquiries.....	.....do.....	29	104	1	1897	8,000.00	7,873.97	126.03
Publications.....	.....do.....	29	104	1	1897	70,000.00	67,709.89	2,290.11
Purchase and distribution of valuable seeds.....	.....do.....	29	106	1	1897	150,000.00	142,822.52	7,177.48
Bureau of Animal Industry.....	.....do.....	29	106	1	1897	650,000.00	642,715.68	7,284.32
Weather Bureau.....	.....do.....	29	107	1	1897	c 883,876.28	870,581.46	13,294.82
Salaries, officers and clerks.....	Apr. 23, 1897	30	1	1	1898	319,300.00	{ 285,181.30 18,962.98	5,118.70 37.02
Furniture, cases, and repairs.....	.....do.....	30	8	1	1898	9,000.00	{ 9,811.02 7,851.30	188.98 1,148.70
Library.....	.....do.....	30	7	1	1898	7,000.00	{ 6,734.81 7,734.81	265.19 7,284.32
Museum.....	.....do.....	30	8	1	1898	3,000.00	{ 2,906.02 3,000.00	93.98 1,500.00
Postage.....	.....do.....	30	8	1	1898	3,000.00	{ 2,061.73 25,000.00	2,938.27 2,938.27
Contingent expenses.....	.....do.....	30	8	1	1898	25,000.00	{ 10,897.98 12,000.00	1,102.02 7,102.02
Animal quarantine stations.....	.....do.....	30	7	1	1898	12,000.00	{ 92,896.01 9,021.09	7,103.99 978.91
Collecting agricultural statistics.....	.....do.....	30	3	1	1898	110,000.00	{ 9,021.09	978.91
Botanical investigations and experiments.....	.....do.....	30	4	1	1898	15,000.00	{ 14,714.50 20,000.00	285.50 7,284.32
Entomological investigations.....	.....do.....	30	4	1	1898	20,000.00	{ 18,966.67 20,000.00	264.98 373.33
Vegetable pathological investigations.....	.....do.....	30	4	1	1898	20,000.00	{ 660.00 16,160.90	..... 1,339.10
Biological investigations.....	.....do.....	30	4	1	1898	17,500.00	{ 7,487.93 3,913.86	512.07 86.14
Pomological investigations.....	.....do.....	30	4	1	1898	8,000.00	{ 900.00 6,781.71	..... 781.29
Laboratory.....	.....do.....	30	5	1	1898	12,400.00	{ 19,831.32 20,000.00	..... 168.68
Forestry investigations.....	.....do.....	30	5	1	1898	20,000.00	{ 24,937.31 9,199.82	62.69 140.18
Experimental gardens and grounds.....	.....do.....	30	5	1	1898	25,000.00	{ 660.00	.....
Soil investigations.....	.....do.....	30	5	1	1898	10,000.00	{ 8,877.68 3,639.05	1,122.32 1,340.95
Grass and forage plant investigations.....	.....do.....	30	6	1	1898	10,000.00	{ 29,413.10 4,925.80	586.90 74.20
Fiber investigations.....	.....do.....	30	6	1	1898	5,000.00	{ 14,872.88 7,978.44	127.12 21.56
Agricultural experiment stations (\$755,000 <sup>a</sup> ).....	.....do.....	30	6	1	1898	35,000.00	{ 34,966.55 29,812.59	33.45 187.41
Nutrition investigations.....	.....do.....	30	6	1	1898	15,000.00	{ 8,778.38 315,986.70	5,863.65 3,313.30
Public road inquiries.....	.....do.....	30	7	1	1898	8,000.00	{ 8,667.75 5,659.51	332.25 340.49
Publications, including Farmers' Bulletins.....	.....do.....	30	7	1	1898	65,000.00	{ 2,469.36 2,000.00	34.64 .....
Investigating production of domestic sugar.....	.....do.....	30	39	1	1898	5,000.00	{ 4,941.32 121,870.38	58.68 8,129.62
Purchase and distribution of valuable seeds.....	.....do.....	30	8	1	1898	130,000.00	{ 673,444.02 1,200.00	355.98 .....
Salaries and expenses, Bureau of Animal Industry.....	.....do.....	30	9	1	1898	675,000.00	{ 877,838.35 319,300.00	5,863.65 3,313.30
Weather Bureau.....	.....do.....	30	9	1	1898	883,702.00	{ 8,667.75 6,000.00	332.25 340.49
Salaries, officers and clerks.....	Mar. 22, 1898	30	330	1	1899	319,300.00	{ 5,659.51 2,000.00	340.49 .....
Furniture, cases, and repairs.....	.....do.....	30	336	1	1899	9,000.00	{ 2,469.36 25,000.00	34.64 1,111.92
Library.....	.....do.....	30	336	1	1899	6,000.00	{ 2,000.00 12,000.00	..... 166.62
Museum.....	.....do.....	30	336	1	1899	1,500.00	{ 11,833.38 105,000.00	34.64 4,047.52
Postage.....	.....do.....	30	336	1	1899	2,000.00	{ 2,000.00 20,000.00	..... 27.93
Contingent expenses.....	.....do.....	30	337	1	1899	25,000.00	{ 23,888.08 11,833.38	..... 166.62
Animal quarantine stations.....	.....do.....	30	336	1	1899	12,000.00	{ 11,833.38 100,952.48	..... 4,047.52
Collecting agricultural statistics.....	.....do.....	30	333	1	1899	105,000.00	{ 19,972.07 20,000.00	..... 27.93
Botanical investigations and experiments.....	.....do.....	30	333	1	1899	20,000.00	{ 19,972.07	27.93

<sup>a</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

<sup>b</sup> Includes \$127.25 from the sale of card index.

<sup>c</sup> Includes \$104.28 from the sale of Weather Bureau publications.



*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Entomological investigations.	Mar. 22, 1898	30	333	1	1899	\$20,000.00	\$19,812.64	\$187.36
Vegetable pathological investigations.	do.	30	333	1	1899	20,000.00	19,634.32	365.68
Biological investigations.	do.	30	334	1	1899	17,500.00	17,373.26	126.74
Pomological investigations.	do.	30	334	1	1899	9,500.00	8,248.18	1,251.82
Laboratory.	do.	30	334	1	1899	12,400.00	12,028.15	371.85
Forestry investigations.	do.	30	334	1	1899	20,000.00	19,520.52	469.48
Experimental gardens and grounds.	do.	30	334	1	1899	20,000.00	19,879.66	120.34
Soil investigations.	do.	30	334	1	1899	10,000.00	9,885.85	114.15
Grass and forage plant investigations.	do.	30	335	1	1899	10,000.00	9,950.99	49.01
Irrigation information.	do.	30	335	1	1899	10,000.00	9,997.49	2.51
Agricultural experiment stations (760,000 <sup>a</sup> ).	do.	30	335	1	1899	40,000.00	39,536.38	463.62
Nutrition investigations.	do.	30	335	1	1899	15,000.00	14,903.08	96.92
Public road inquiries.	do.	30	336	1	1899	8,000.00	7,469.50	530.50
Publications.	do.	30	336	1	1899	65,000.00	64,773.62	226.38
Purchase and distribution of valuable seeds.	do.	30	337	1	1899	130,000.00	128,330.61	1,649.39
Investigating production of domestic sugar.	do.	30	338	1	1899	7,000.00	6,860.30	139.70
Salaries and expenses, Bureau of Animal Industry.	do.	30	338	1	1899	900,000.00	892,164.47	6,828.45
Weather Bureau.	do.	30	339	1	1899	1,015,502.00	1,008,971.30	6,530.70
Salaries, officers and clerks.	Mar. 1, 1899	30	947	1	1900	336,340.00	330,666.24	5,673.76
Furniture, cases, and repairs.	do.	30	955	1	1900	10,000.00	9,771.27	228.73
Library.	do.	30	954	1	1900	5,000.00	4,291.17	708.83
Museum.	do.	30	954	1	1900	1,500.00	1,490.01	9.99
Postage.	do.	30	954	1	1900	2,000.00	2,000.00	—
Contingent expenses.	do.	30	955	1	1900	25,000.00	23,769.38	1,230.62
Animal quarantine stations.	do.	30	954	1	1900	12,000.00	11,477.87	522.13
Collecting agricultural statistics.	do.	30	950	1	1900	110,000.00	107,653.62	2,346.38
Botanical investigations and experiments.	do.	30	950	1	1900	20,000.00	19,689.51	310.49
Entomological investigations.	do.	30	951	1	1900	20,000.00	19,920.64	79.36
Vegetable pathological investigations.	do.	30	951	1	1900	26,000.00	25,854.44	145.56
Biological investigations.	do.	30	951	1	1900	17,500.00	17,344.00	156.00
Pomological investigations.	do.	30	951	1	1900	9,500.00	9,099.61	400.39
Laboratory.	do.	30	951	1	1900	17,700.00	17,182.80	517.20
Forestry investigations.	do.	30	952	1	1900	40,000.00	39,991.49	8.51
Experimental gardens and grounds.	do.	30	952	1	1900	28,000.00	27,589.66	410.34
Soil investigations.	do.	30	952	1	1900	20,000.00	19,717.02	282.98
Grass and forage plant investigations.	do.	30	952	1	1900	12,000.00	11,566.84	433.16
Irrigation investigations.	do.	30	953	1	1900	35,000.00	33,732.57	1,267.43
Agricultural experiment stations (\$765,000 <sup>a</sup> ).	do.	30	953	1	1900	45,000.00	43,702.20	1,297.80
Nutrition investigations.	do.	30	953	1	1900	15,000.00	14,950.86	49.14
Public road inquiries.	do.	30	954	1	1900	8,000.00	7,854.35	145.65
Publications.	do.	30	954	1	1900	80,000.00	79,516.76	483.24
Purchase and distribution of valuable seeds.	do.	30	955	1	1900	130,000.00	128,366.12	1,633.87
Investigating production of domestic sugar.	do.	30	956	1	1900	7,000.00	6,717.82	282.18
Tea-culture investigations.	do.	30	956	1	1900	1,000.00	999.33	.67
Salaries and expenses, Bureau of Animal Industry.	do.	30	956	1	1900	950,000.00	918,449.03	31,550.97
Weather Bureau.	do.	30	957	1	1900	1,022,482.00	1,014,238.80	8,243.20
Salaries, officers and clerks.	May 20, 1900	31	191	1	1901	326,680.00	319,809.25	6,870.75
Library.	do.	31	194	1	1901	5,000.00	4,118.93	881.07
Contingent expenses.	do.	31	194	1	1901	37,000.00	35,623.95	1,376.05
Animal quarantine stations.	do.	31	194	1	1901	50,000.00	49,343.52	656.48
Collecting agricultural statistics.	do.	31	194	1	1901	110,000.00	109,729.76	270.24
Botanical investigations and experiments.	do.	31	195	1	1901	30,000.00	29,590.49	409.51
Entomological investigations.	do.	31	195	1	1901	22,500.00	22,265.57	234.43
Vegetable pathological investigations.	do.	31	195	1	1901	28,000.00	27,488.57	511.43

<sup>a</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

<sup>b</sup> Includes \$26,992.92 received from sale of American products in Europe.

*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Biological investigations.....	May 20, 1906	31	196	1	1901	\$17,500.00	\$17,195.83	\$304.17
Pomological investigations.....	do.	31	196	1	1901	9,500.00	9,315.11	184.89
Laboratory.....	do.	31	196	1	1901	28,500.00	28,395.45	104.55
Forestry investigations.....	do.	31	197	1	1901	80,000.00	79,695.87	304.13
Experimental gardens and grounds.....	do.	31	197	1	1901	20,000.00	19,986.72	13.28
Soil investigations.....	do.	31	197	1	1901	25,000.00	24,924.94	75.06
Grass and forage plant investigations.....	do.	31	198	1	1901	17,000.00	15,225.83	1,774.17
Irrigation investigations.....	do.	31	199	1	1901	50,000.00	49,973.09	26.91
Agricultural experiment stations (\$780,000 <sup>a</sup> ).....	do.	31	198	1	1901	<sup>b</sup> 60,251.01	59,883.47	367.54
Nutrition investigations.....	do.	31	199	1	1901	17,500.00	17,499.67	.33
Arlington experimental farm.....	do.	31	199	1	1901	10,000.00	9,946.03	53.97
Public road inquiries.....	do.	31	200	1	1901	14,000.00	13,990.76	9.24
Publications.....	do.	31	200	1	1901	105,000.00	104,680.67	319.33
Purchase and distribution of valuable seeds.....	do.	31	200	1	1901	170,000.00	149,615.49	20,384.51
Investigating production of domestic sugar.....	do.	31	201	1	1901	7,000.00	6,690.25	309.75
Tea-culture investigations.....	do.	31	202	1	1901	5,000.00	4,959.42	40.58
Salaries and expenses, Bureau of Animal Industry.....	do.	31	202	1	1901	<sup>c</sup> 1,000,514.96	976,566.75	23,948.21
Weather Bureau:								
Salaries.....	do.	31	202	1	1901	153,320.00	152,688.11	631.89
Fuel, lights, and repairs.....	do.	31	203	1	1901	9,000.00	8,877.36	122.64
Contingent expenses.....	do.	31	203	1	1901	8,000.00	7,906.40	93.60
General expenses.....	do.	31	203	1	1901	828,000.00	823,921.78	4,078.22
Meteorological observation stations.....	do.	31	204	1	1901	60,000.00	59,019.49	980.51
Salaries.....	Mar. 2, 1901	31	922	1	1902	373,820.00	370,039.69	3,780.31
Library.....	do.	31	934	1	1902	7,000.00	6,754.06	245.94
Contingent expenses.....	do.	31	934	1	1902	37,000.00	34,543.24	2,456.76
Animal quarantine stations.....	do.	31	926	1	1902	25,000.00	24,814.88	185.12
Collecting agricultural statistics.....	do.	31	934	1	1902	120,000.00	117,060.06	2,939.94
Botanical investigations and experiments.....	do.	31	928	1	1902	45,000.00	44,950.93	49.07
Entomological investigations.....	do.	31	931	1	1902	28,513.18	27,069.77	1,443.41
Vegetable pathological investigations.....	do.	31	927	1	1902	60,000.00	59,999.45	.55
Biological investigations.....	do.	31	932	1	1902	20,000.00	19,807.80	192.20
Pomological investigations.....	do.	31	927	1	1902	20,000.00	19,985.14	14.86
Laboratory.....	do.	31	930	1	1902	24,500.00	24,417.47	82.53
Forestry investigations.....	do.	31	929	1	1902	146,280.00	145,809.76	470.24
Experimental gardens and grounds.....	do.	31	929	1	1902	20,000.00	19,725.80	274.20
Soil investigations.....	do.	31	931	1	1902	91,000.00	89,987.21	1,012.79
Grass and forage plant investigations.....	do.	31	928	1	1902	20,000.00	19,566.91	433.09
Irrigation investigations.....	do.	31	936	1	1902	50,000.00	49,980.86	19.14
Agricultural experiment stations (\$789,000 <sup>a</sup> ).....	do.	31	935	1	1902	<sup>d</sup> 69,157.05	69,052.71	104.34
Nutrition investigations.....	do.	31	936	1	1902	20,000.00	19,951.48	48.52
Arlington experimental farm.....	do.	31	936	1	1902	10,000.00	9,897.16	102.84
Plans for building Department of Agriculture, 1901-2.....	do.	31	938	1	1902	5,000.00	5,000.00	-----
Public road inquiries.....	do.	31	938	1	1902	20,000.00	19,957.01	42.99
Publications.....	do.	31	933	1	1902	188,000.00	187,657.52	342.48
Purchase and distribution of valuable seeds.....	do.	31	937	1	1902	270,000.00	266,614.22	3,385.78
Investigating production of domestic sugar.....	do.	31	936	1	1902	5,000.00	4,346.31	653.69
Tea-culture investigations.....	do.	31	937	1	1902	7,000.00	6,816.25	183.75
Bureau of Animal Industry.....	do.	31	925	1	1902	1,092,190.28	1,092,100.94	89.34
Weather Bureau:								
Salaries.....	do.	31	923	1	1902	159,820.00	159,769.71	50.29
Fuel, lights, and repairs.....	do.	31	923	1	1902	9,000.00	8,919.71	80.29
Contingent expenses.....	do.	31	923	1	1902	8,000.00	7,942.81	57.19
General expenses.....	do.	31	923	1	1902	865,500.00	864,490.74	1,009.26
Meteorological observation stations.....	do.	31	924	1	1902	60,000.00	59,646.49	353.51
Buildings.....	do.	31	924	1	1902	46,000.00	46,000.00	-----

<sup>a</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

<sup>b</sup> Including \$251.01 received from sales of card index.

<sup>c</sup> Including \$514.96 received from sales of American butter in foreign markets.

<sup>d</sup> Including \$157.05 received from sales of card index.

*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Salaries.....	June 3, 1902	32	286	1	1903	\$465,500.00	\$450,976.17	\$14,523.83
Library.....	do.....	32	300	1	1903	8,000.00	7,635.11	364.89
Contingent expenses.....	do.....	32	301	1	1903	37,000.00	42,916.14	83.86
Urgent deficiency, contingent.....	do.....	32	1062	1	1903	6,000.00		
Vegetable pathological investigations.....	do.....	32	291	1	1903	105,000.00	103,646.28	1,353.72
Vegetable pathological investigations, 1902-3.....	do.....	32	1152	1	1903	5,000.00	4,130.02	869.98
Pomological investigations.....	do.....	32	291	1	1903	30,000.00	29,606.83	393.17
Botanical investigations and experiments.....	do.....	32	292	1	1903	55,000.00	54,900.42	99.58
Grass and forage plant investigations.....	do.....	32	292	1	1903	30,000.00	29,527.41	472.59
Experimental gardens and grounds.....	do.....	32	293	1	1903	25,000.00	24,935.74	64.26
Arlington experimental farm.....	do.....	32	293	1	1903	15,000.00	14,998.81	1.19
Investigating production of domestic sugar.....	do.....	32	295	1	1903	5,000.00	4,065.10	934.90
Tea-culture investigations.....	do.....	32	293	1	1903	10,000.00	7,500.10	2,499.90
Purchase and distribution of valuable seeds.....	do.....	32	293	1	1903	270,000.00	266,229.81	3,770.19
Forestry investigations.....	do.....	32	295	1	1903	254,000.00	244,781.68	9,218.32
Laboratory.....	do.....	32	296	1	1903	60,500.00	59,518.91	913.09
Soil investigations.....	do.....	32	297	1	1903	130,000.00	128,408.15	1,591.85
Entomological investigations.....	do.....	32	298	1	1903	37,500.00	37,485.44	14.56
Entomological investigations, 1902-3.....	do.....	32	298	1	1903	8,000.00	7,989.42	10.58
Biological investigations.....	do.....	32	298	1	1903	26,000.00	25,616.80	383.20
Biological investigations, 1902-3.....	do.....	32	298	1	1903	2,000.00	1,949.61	50.39
Urgent deficiency publications.....	do.....	32	1062	1	1903	200,000.00	190,961.49	13,038.51
Collecting agricultural statistics.....	do.....	32	300	1	1903	4,000.00		
Agricultural experiment stations (\$796,000 <sup>a</sup> ).....	do.....	32	301	1	1903	94,200.00	94,023.27	176.73
Amount of deposits.....	do.....	32	301	1	1903	76,000.00	77,552.69	333.31
Nutrition investigations.....	do.....	32	302	1	1903	1,886.00		
Irrigation investigations.....	do.....	32	302	1	1903	20,000.00	19,901.12	98.88
Public road inquiries.....	do.....	32	302	1	1903	65,000.00	62,201.12	2,798.88
Foreign market investigations.....	do.....	32	302	1	1903	30,000.00	29,996.13	3.87
Silk investigations.....	do.....	32	300	1	1903	6,500.00	6,140.02	359.98
Expenses, Bureau of Animal Industry.....	do.....	32	303	1	1903	10,000.00	7,133.32	2,866.68
Urgent deficiency, Bureau of Animal Industry.....	do.....	32	289	1	1903	1,660,000.00	1,444,113.05	215,886.95
Weather Bureau:	do.....	32	1165	1	1903	500,000.00		
Salaries.....	do.....	32	286	1	1903	165,260.00	164,927.46	332.54
Fuel, lights, and repairs.....	do.....	32	287	1	1903	10,000.00	9,964.65	35.35
Contingent expenses.....	do.....	32	287	1	1903	8,000.00	7,806.38	193.62
General expenses.....	do.....	32	287	1	1903	915,000.00	428,219.24	1,280.76
Meteorological observation stations.....	do.....	32	288	1	1903	480,377.71	59,628.24	371.76
Buildings.....	do.....	32	288	1	1903	60,000.00	49,467.00	533.00
Cables and land lines.....	do.....	32	288	1	1903	40,000.00	40,000.00	-----
Storm - warning stations, Glenhaven and South Manitou Island, Mich.....	do.....	32	288	1	1903	15,000.00	15,000.00	-----
Salaries, officers and clerks.....	Mar. 3, 1903	32	1147	1	1904	470,080.00	458,295.90	11,784.10
Salaries, extra laborers.....	do.....	32	1147	1	1904	1,000.00	982.01	17.99
Bureau of Animal Industry:	do.....	32	1150	1	1904	1,200,000.00	1,199,410.98	589.02
General expenses, including \$1,800 for rent of building.....	do.....	32	1150	1	1904	250,000.00	249,868.64	131.06
To eradicate contagious diseases of animals.....	do.....	32	1152	1	1904	122,000.00	122,889.98	.06
Bureau of Plant Industry:	do.....	32	1152	1	1904	3,000.00	2,109.96	
Vegetable pathological investigations.....	do.....	32	1152	1	1904	5,000.00	4,998.41	1.59
Rent of building.....	do.....	32	1153	1	1904	37,000.00	35,636.08	1,363.92
Pomological investigations.....	do.....	32	1153	1	1904	37,000.00	35,636.08	1,363.92

<sup>a</sup> Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

<sup>b</sup> Receipts from sales of certain products of Alaska, Hawaii, and Porto Rico experiment stations.



*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Plant Industry—Continued.								
Botanical investigations and experiments	Mar. 3, 1903	32	1153	1	1904	\$62,000.00	\$60,693.23	\$1,306.77
Rent of building	.....do.....	32	1153	1	1904	3,000.00	3,000.00	.....
Grass and forage plant investigations	.....do.....	32	1154	1	1904	33,800.00	34,514.48	} 235.52
Rent of building	.....do.....	32	1154	1	1904	1,200.00	250.00	
Experimental gardens and grounds, Department of Agriculture	.....do.....	32	1154	1	1904	25,000.00	24,984.11	15.89
Arlington Experimental Farm	.....do.....	32	1155	1	1904	15,000.00	14,972.99	27.01
Tea-culture investigations	.....do.....	32	1155	1	1904	10,000.00	8,701.07	1,298.93
Purchase and distribution of valuable seeds	.....do.....	32	1155	1	1904	257,000.00	257,247.74	256.26
Foreign seed and plant introduction	.....do.....	32	1155	1	1904	30,000.00	27,483.93	2,012.07
Rent of building	.....do.....	32	1156	1	1904	3,000.00	.....	3,000.00
Investigating production of domestic sugar	.....do.....	32	1156	1	1904	5,000.00	4,249.41	750.59
Bureau of Forestry:								
Forestry investigations, including \$10,000 for rent of building	.....do.....	32	1156	1	1904	312,860.00	311,588.63	1,271.37
Protection of forest reserves <sup>a</sup>	.....do.....	.....	.....	.....	.....	16,864.01	341.12	16,522.89
Bureau of Chemistry:								
Laboratory, including \$5,000 for table sirup	.....do.....	32	1157	1	1904	60,500.00	60,317.39	182.61
Laboratory, table sirup, 1903-4	.....do.....	32	1157	1	1904	10,000.00	9,898.89	101.11
Bureau of Soils, including \$2,000 for rent of building	.....do.....	32	1159	1	1904	170,000.00	166,286.32	3,713.68
Entomological investigations	.....do.....	32	1160	1	1904	43,500.00	39,114.76	4,385.24
Silk investigations	.....do.....	32	1160	1	1904	10,000.00	9,035.31	944.69 <sup>a</sup>
Entomological investigations, 1903-4	.....do.....	32	1160	1	1904	12,000.00	11,825.82	174.18
Biological investigations, including \$1,000 for care of game	.....do.....	32	1160	1	1904	34,000.00	33,066.92	933.08
Publications, Department of Agriculture, Farmers' Bulletins	.....do.....	32	1161	1	1904	105,000.00	104,997.90	2.10
Artists, etc.	.....do.....	32	1161	1	1904	10,000.00	9,992.49	7.51
Labor, etc.	.....do.....	32	1161	1	1904	85,000.00	84,746.73	253.27
Collecting agricultural statistics	.....do.....	32	1162	1	1904	104,200.00	103,225.90	974.10
Collecting agricultural statistics, 1903-4	.....do.....	32	1162	1	1904	5,000.00	4,996.84	3.16
Foreign-market investigations	.....do.....	32	1162	1	1904	7,500.00	7,455.40	44.60
Library, Department of Agriculture	.....do.....	32	1163	1	1904	10,000.00	9,972.93	27.07
Contingent expenses, Department of Agriculture	.....do.....	32	1163	1	1904	37,000.00	36,999.77	.23
Agricultural experiment stations (\$810,000 <sup>b</sup> )	.....do.....	32	1163	1	1904	40,000.00	39,997.74	2.26
Stations of Alaska	.....do.....	32	1164	1	1904	15,000.00	15,000.00	.....
Stations of Hawaii	.....do.....	32	1164	1	1904	15,000.00	15,000.00	.....
Stations of Porto Rico	.....do.....	32	1164	1	1904	15,000.00	15,000.00	.....
Farmers' institutes	.....do.....	32	1164	1	1904	5,000.00	4,838.69	161.31
Nutrition investigations	.....do.....	32	1164	1	1904	20,000.00	19,994.18	5.82
Irrigation investigations	.....do.....	32	1165	1	1904	65,000.00	64,938.65	61.35
Public road inquiries	.....do.....	32	1165	1	1904	32,000.00	31,813.00	187.00
Public road inquiries, 1903-4	.....do.....	32	1165	1	1904	3,000.00	3,000.00	.....
Weather Bureau:								
Salaries	.....do.....	32	1148	1	1904	175,440.00	175,098.94	341.06
Fuel, lights, and repairs	.....do.....	32	1148	1	1904	6,000.00	5,981.63	18.37
Contingent expenses	.....do.....	32	1148	1	1904	8,000.00	7,818.52	181.48
General expenses, salaries	.....do.....	32	1149	1	1904	472,300.00	471,917.22	382.78
General expenses, miscellaneous	.....do.....	32	1149	1	1904	496,780.00	494,741.03	2,038.97
Buildings	.....do.....	32	1149	1	1904	50,000.00	50,000.00	.....
Cables and land lines	.....do.....	32	1149	1	1904	40,000.00	40,000.00	.....

<sup>a</sup> This appropriation and amount transferred from Department of Interior.

<sup>b</sup> Of this amount, \$720,000 was paid directly to the experiment stations from the Treasury Department.

*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

Purpose.	Date of ap- propriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropri- ated.	Amount disbursed.	Amount unex- pended.
		Vol.	Page.	Sec.				
Salaries, officers and clerks....	Apr. 23, 1904	33	276	1	1905	\$481,300.00	\$407,998.89	\$10,301.11
Salaries, extra laborers.....	.....do.....	33	277	1	1905	1,000.00	971.66	28.34
Bureau of Animal Industry:								
Deficiency appropriation.....	.....do.....	33	1242	1	1905	150,000.00		
General expenses, including \$1,800 for rent of building.....	.....do.....	33	279	1	1905	1,250,000.00	1,399,100.85	899.15
Animal breeding and feeding.....	.....do.....	33	281	1	1905	25,000.00	20,540.67	4,459.33
To eradicate contagious dis- eases of animals, 1904-5 <sup>a</sup> .....	.....do.....	33	5	1	1905	250,000.00	248,980.79	1,019.21
Bureau of Plant Industry:								
Vegetable pathological inves- tigations.....	.....do.....	33	281	1	1905	145,000.00	145,705.01	.....
Rent of building.....	.....do.....	33	281	1	1905	3,000.00	2,294.99	.....
Vegetable pathological inves- tigations, 1904-5.....	.....do.....	33	281	1	1905	2,000.00	2,000.00	.....
Rent of quarters (defi- ciency).....	.....do.....	33	603	1	1905	2,500.00	2,485.00	15.00
Pomological investigations <sup>b</sup> .....	.....do.....	33	282	1	1905	43,500.00	43,657.69	2,268.52
Botanical investigations and experiments.....	.....do.....	33	283	1	1905	64,500.00	63,972.36	527.64
Rent of building.....	.....do.....	33	283	1	1905	3,000.00	3,000.00	.....
Grass and forage plant inves- tigations.....	.....do.....	33	283	1	1905	40,500.00	40,012.04	487.96
Rent of building.....	.....do.....	33	283	1	1905	2,000.00	1,500.00	500.00
Experimental gardens and grounds, Department of Agriculture.....	.....do.....	33	284	1	1905	25,000.00	24,725.40	274.60
Greenhouses, Department of Agriculture, 1904-5.....	.....do.....	33	284	1	1905	25,000.00	24,995.32	4.68
Arlington Experimental Farm.....	.....do.....	33	284	1	1905	20,000.00	19,818.95	181.05
Tea-culture investigations.....	.....do.....	33	284	1	1905	10,000.00	8,387.15	1,612.85
Purchase and distribution of valuable seeds <sup>c</sup> .....	.....do.....	33	285	1	1905	242,500.00	240,134.03	2,365.97
Foreign seed and plant in- troduction <sup>c</sup> .....	.....do.....	33	286	1	1905	40,000.00	39,687.44	312.56
Repairs to building.....	.....do.....	33	285	1	1905	7,500.00	4,000.00	3,500.00
Investigating production of domestic sugar.....	.....do.....	33	286	1	1905	7,500.00	7,222.14	277.86
Bureau of Forestry:								
Forestry investigations, in- cluding \$15,500 for rent of building.....	.....do.....	33	286	1	1905	388,000.00	386,566.66	1,433.34
Testing timbers, Louisiana Purchase Exposition, St. Louis, Mo. (deficiency act).....	.....do.....	33	1242	1	1905	10,000.00	9,985.82	14.18
Bureau of Chemistry:								
Laboratory, including \$15,000 for table sirup.....	.....do.....	33	287	1	1905	105,000.00	103,693.95	1,306.05
Laboratory, 1904-5.....	.....do.....	33	288	1	1905	15,000.00	14,716.95	283.05
Laboratory road materials.....	.....do.....	33	288	1	1905	15,000.00	14,802.99	197.01
Bureau of Soils:								
Soil investigations, includ- ing \$6,000 for rent of build- ing.....	.....do.....	33	288	1	1905	170,000.00	168,638.84	1,361.16
Entomological investigations.....	.....do.....	33	289	1	1905	70,000.00	68,983.63	1,016.37
Cotton boll-weevil investi- gations, 1904-5 <sup>a</sup> .....	.....do.....	33	5	1	1905	250,000.00	220,782.04	29,217.96
Biological investigations.....	.....do.....	33	290	1	1905	33,000.00	32,937.70	62.30
Biological investigations, 1904-5, care of elk.....	.....do.....	33	291	1	1905	1,000.00	807.14	192.86
Publications, Department of Agriculture, Farmers' Bul- letins.....	.....do.....	33	291	1	1905	105,000.00	104,885.16	114.84
Artists, etc.....	.....do.....	33	291	1	1905	15,000.00	14,635.28	364.72
Labor, etc.....	.....do.....	33	291	1	1905	89,000.00	88,985.64	14.35
Labor, etc., 1904-5.....	.....do.....	33	291	1	1905	1,000.00	430.64	569.36
Collecting agricultural sta- tistics.....	.....do.....	33	292	1	1905	132,000.00	130,522.28	1,477.72
Foreign-market investiga- tions.....	.....do.....	33	292	1	1905	7,500.00	6,069.72	1,430.28

<sup>a</sup> By transfer from cotton boll weevil to Bureau of Animal Industry, 1904-5..... 3,500.00

<sup>b</sup> By receipts from sale of fruits and vegetables (Pomological investigations)..... 2,426.21

<sup>c</sup> By transfer from foreign to domestic seeds..... 4,183.54

*Statement of appropriations disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Library, Department of Agriculture .....	Apr. 23, 1904	33	293	1	1905	\$10,000.00	\$9,627.92	\$372.08
Contingent expenses, Department of Agriculture .....	.....do.....	33	293	1	1905	37,000.00	36,953.00	47.00
Agricultural experiment stations (\$810,000 <i>a</i> ) .....	.....do.....	33	293	1	1905	40,000.00	39,703.10	296.90
Stations of Alaska .....	.....do.....	33	294	1	1905	15,000.00	15,000.00	.....
Stations of Hawaii .....	.....do.....	33	294	1	1905	15,000.00	15,000.00	.....
Stations of Porto Rico .....	.....do.....	33	294	1	1905	15,000.00	15,000.00	.....
Farmers' institutes .....	.....do.....	33	294	1	1905	5,000.00	4,603.53	396.47
Nutrition investigations .....	.....do.....	33	294	1	1905	20,000.00	19,976.98	23.02
Irrigation investigations .....	.....do.....	33	294	1	1905	67,500.00	67,416.45	83.55
Public road inquiries .....	.....do.....	33	295	1	1905	35,000.00	34,319.03	680.97
Building, Department of Agriculture .....	.....do.....	32	806	1	1905	250,000.00	108,496.32	141,503.68
Weather Bureau:								
Salaries .....	.....do.....	33	277	1	1905	180,440.00	180,225.57	214.43
Fuel, lights, and repairs .....	.....do.....	33	278	1	1905	8,000.00	7,979.20	20.80
Contingent expenses .....	.....do.....	33	278	1	1905	10,000.00	9,691.93	308.07
General expenses, salaries .....	.....do.....	33	278	1	1905	492,300.00	491,725.31	574.69
General expenses, miscellaneous .....	.....do.....	33	279	1	1905	572,000.00	569,792.31	2,207.69
Buildings .....	.....do.....	33	279	1	1905	48,000.00	47,803.11	196.89
Cables and land lines .....	.....do.....	33	279	1	1905	27,000.00	26,991.09	8.91
Salaries, officers and clerks .....	Mar. 3, 1905 <sup>b</sup>	33	861	1	1906	804,970.00	782,913.30	22,056.70
Salaries, extra labor .....	.....do.....	33	861	1	1906	10,000.00	8,820.34	1,179.66
Bureau of Animal Industry:								
Deficiency act .....	Feb. 27, 1906				1906	63,000.00	29,863.06	33,136.94
General expenses .....	Mar. 3, 1905	33	864	1	1906	1,429,020.00	1,256,254.31	172,765.69
Animal breeding and feeding .....	.....do.....	33	866	1	1906	25,000.00	16,651.32	8,348.68
Rent of buildings .....	.....do.....	33	865	1	1906	2,500.00	1,653.02	846.98
Bureau of Plant Industry:								
Vegetable pathological investigations .....	.....do.....	33	867	1	1906	139,640.00	122,341.52	17,298.48
Rent of building .....	.....do.....	33	867	1	1906	6,000.00	3,070.00	2,930.00
Vegetable pathological investigations, 1905-6 .....	.....do.....	33	868	1	1906	10,000.00	7,278.05	2,721.95
Grain investigations .....	.....do.....	33	868	1	1906	25,000.00	20,040.29	4,959.71
Pomological investigations .....	.....do.....	33	868	1	1906	33,640.00	32,464.49	1,175.51
Rent of building .....	.....do.....	33	868	1	1906	2,000.00	1,870.00	130.00
Botanical investigations and experiments .....	.....do.....	33	869	1	1906	60,840.00	54,517.26	6,322.74
Rent of building .....	.....do.....	33	869	1	1906	3,000.00	2,750.00	250.00
Grass and forage plant investigations .....	.....do.....	33	869	1	1906	37,160.00	30,768.51	6,391.49
Rent of building .....	.....do.....	33	869	1	1906	2,500.00	1,375.00	1,125.00
Experimental gardens and grounds .....	.....do.....	33	870	1	1906	15,320.00	13,837.04	1,482.96
Experimental gardens and grounds, 1905-6 .....	.....do.....	33	870	1	1906	5,000.00	4,807.82	192.18
Arlington experimental farm .....	.....do.....	33	870	1	1906	20,000.00	19,040.13	959.87
Tea-culture investigations .....	.....do.....	33	870	1	1906	8,500.00	6,910.79	1,589.21
Purchase and distribution of valuable seeds .....	.....do.....	33	870	1	1906	195,140.00	186,325.12	8,814.88
Foreign seed and plant introduction .....	.....do.....	33	871	1	1906	37,780.00	28,406.09	9,373.91
Repairs to building .....	.....do.....	33	871	1	1906	10,000.00	.....	10,000.00
Investigating production of domestic sugar .....	.....do.....	33	872	1	1906	7,500.00	6,489.06	1,010.94
Forest Service:								
General expenses, Forest Service .....	.....do.....	33	872	1	1906	768,180.00	722,031.96	46,148.04
Rent of buildings .....	.....do.....	33	873	1	1906	25,000.00	14,056.85	10,943.15
Bureau of Chemistry, laboratory, including \$3,000 for table sirup .....	.....do.....	33	873	1	1906	130,920.00	117,359.87	13,560.13
Bureau of Soils, soil investigations, including \$4,000 for rent of building .....	.....do.....	33	875	1	1906	170,000.00	162,268.42	7,731.58
Bureau of Entomology, entomological investigations, including \$2,500 for moth investigations .....	.....do.....	33	876	1	1906	68,060.00	63,292.82	4,767.18

*a* Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

*b* For the years 1905 and 1906 the figures represent payments made to close of June 30, 1906, the accounts for those years being still open at the date of this revision.



*Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.*

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Biological Survey:								
Biological investigations.....	Mar. 3, 1905	33	877	1	1906	\$44,420.00	\$42,534.43	\$1,885.57
Publications, Department of Agriculture, farmers' bulletins.....	.....do.....	33	878	1	1906	98,750.00	96,461.42	2,288.58
Artists, etc.....	.....do.....	33	878	1	1906	3,500.00	3,427.08	72.92
Labor, etc.....	.....do.....	33	879	1	1906	30,000.00	28,036.26	1,963.74
Bureau of Statistics:								
Collecting agricultural statistics.....	.....do.....	33	879	1	1906	93,900.00	82,104.53	11,795.47
Foreign market investigations.....	.....do.....	33	879	1	1906	4,900.00	4,720.13	179.87
Library, Department of Agriculture.....	.....do.....	33	880	1	1906	8,040.00	6,287.16	1,752.84
Contingent expenses, Department of Agriculture.....	.....do.....	33	880	1	1906	35,000.00	30,597.94	4,402.06
Contingent expenses 1905-6.....	.....do.....	33	880	1	1906	2,000.00	2,000.00	.....
Agricultural experiment stations (\$1,034,660 <sup>a</sup> ).....	.....do.....	33	881	1	1906	21,660.00	20,009.87	1,650.13
Stations of Alaska, including \$3,000 for purchase of live stock.....	.....do.....	33	881	1	1906	18,000.00	16,800.00	1,200.00
Stations of Hawaii.....	.....do.....	33	881	1	1906	15,000.00	15,000.00	.....
Stations of Porto Rico.....	.....do.....	33	881	1	1906	15,000.00	15,000.00	.....
Farmers' Institute.....	.....do.....	33	882	1	1906	5,000.00	4,024.57	975.43
Nutrition investigations.....	.....do.....	33	882	1	1906	20,000.00	17,594.28	2,405.72
Irrigation investigations.....	.....do.....	33	882	1	1906	74,200.00	66,156.35	8,043.65
Public road inquiries.....	.....do.....	33	882	1	1906	37,660.00	32,487.49	5,172.51
Cotton-boll weevil investigations.....	.....do.....	33	883	1	1906	190,000.00	143,014.07	46,985.93
Building, Department of Agriculture.....	} Feb. 9, 1903	32	806	.....	{	250,000.00	469,065.32	480,934.68
Weather Bureau:						700,000.00		
Salaries.....	Mar. 3, 1905	33	862	1	1906	191,430.00	190,930.72	499.28
Fuel, lights, and repairs.....	.....do.....	33	862	1	1906	10,000.00	9,112.13	887.87
Contingent expenses.....	.....do.....	33	863	1	1906	10,000.00	7,879.05	2,120.95
Salaries, station employees.....	.....do.....	33	863	1	1906	531,550.00	487,988.40	43,561.60
General expenses.....	.....do.....	33	863	1	1906	562,010.00	405,296.62	156,713.38
Buildings.....	.....do.....	33	863	1	1906	53,000.00	52,716.93	283.07
Cables and land lines.....	.....do.....	33	864	1	1906	35,000.00	33,626.06	1,373.94

<sup>a</sup> Of this amount, \$960,000 was paid directly to the experiment stations from the Treasury Department.

*Statement of appropriations, disbursements, and unexpended balances for the United States  
Department of Agriculture, etc.—Continued.*

RECAPITULATION.

Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
1839.....	\$1,000.00	\$1,000.00	.....	1874.....	\$257,690.00	\$233,765.78	\$23,924.22
1840.....	.....	.....	.....	1875.....	337,380.00	321,079.83	16,300.17
1841.....	.....	.....	.....	1876.....	249,120.00	198,843.64	50,276.36
1842.....	1,000.00	1,000.00	.....	1877.....	194,686.96	188,206.19	6,480.77
1843.....	.....	.....	.....	1878.....	198,640.00	197,634.94	1,005.06
1844.....	2,000.00	2,000.00	.....	1879.....	206,400.00	206,360.00	40.00
1845.....	2,000.00	2,000.00	.....	1880.....	199,500.00	198,361.72	1,138.28
1846.....	3,000.00	3,000.00	.....	1881.....	275,460.31	267,608.84	<i>b</i> 7,851.47
1847.....	3,000.00	3,000.00	.....	1882.....	363,011.05	354,482.39	<i>c</i> 8,528.66
1848.....	4,500.00	4,500.00	.....	1883.....	456,396.11	438,941.72	<i>d</i> 17,454.39
1849.....	3,500.00	3,500.00	.....	1884.....	<i>a</i> 416,641.13	413,618.09	3,023.04
1850.....	5,500.00	5,500.00	.....	1885.....	<i>a</i> 655,930.25	558,934.89	<i>e</i> 96,995.36
1851.....	5,500.00	5,500.00	.....	1886.....	<i>a</i> 677,973.22	519,196.11	158,777.11
1852.....	5,000.00	5,000.00	.....	1887.....	<i>a</i> 657,641.81	628,287.14	29,354.67
1853.....	5,000.00	5,000.00	.....	1888.....	1,027,219.06	1,011,282.62	15,936.44
1854.....	10,000.00	10,000.00	.....	1889.....	<i>a</i> 1,134,480.66	1,033,590.22	<i>g</i> 100,890.38
1855.....	<i>a</i> 50,000.00	50,000.00	.....	1890.....	<i>a</i> 1,170,139.11	971,823.62	<i>h</i> 198,315.49
1856.....	30,000.00	30,000.00	.....	1891.....	<i>a</i> 1,372,049.21	1,266,277.36	105,771.85
1857.....	75,000.00	75,000.00	.....	1892.....	<i>a</i> 2,303,655.75	2,253,262.29	50,393.46
1858.....	63,500.00	63,157.25	\$342.75	1893.....	2,540,060.72	2,355,430.25	184,630.47
1859.....	60,000.00	60,000.00	.....	1894.....	2,603,855.58	1,977,469.28	<i>i</i> 626,386.30
1860.....	40,000.00	40,000.00	.....	1895.....	2,506,915.00	2,021,030.38	485,884.62
1861.....	60,000.00	60,000.00	.....	1896.....	2,584,013.22	2,034,916.42	489,096.80
1862.....	64,000.00	63,704.21	295.79	1897.....	2,448,763.53	2,348,512.98	100,250.55
1863.....	80,000.00	80,000.00	.....	1898.....	2,467,902.00	2,425,510.44	42,391.56
1864.....	199,770.00	189,270.00	10,500.00	1899.....	2,829,702.00	2,827,795.65	28,899.27
1865.....	112,304.05	112,196.55	107.50	1900.....	3,006,022.00	2,947,603.42	58,418.58
1866.....	167,787.82	167,787.82	.....	1901.....	3,304,265.97	3,239,137.39	65,128.58
1867.....	199,100.00	199,100.00	.....	1902.....	3,922,780.51	3,902,675.79	20,104.72
1868.....	279,020.00	277,094.34	1,925.66	1903.....	5,015,846.00	4,734,230.84	281,615.16
1869.....	172,593.00	172,593.00	.....	1904.....	5,025,024.01	4,969,311.64	55,712.37
1870.....	156,440.00	151,596.93	4,843.07	1905.....	6,094,540.00	5,881,939.57	215,026.64
1871.....	<i>a</i> 188,180.00	186,876.81	1,303.19	1906.....	7,175,690.00	6,000,327.85	1,175,362.15
1872.....	197,070.00	195,977.25	1,092.75	Total.....	\$65,438,391.49	\$60,110,836.13	<i>m</i> 5,415,652.31
1873.....	202,440.00	201,321.22	1,118.78				

*a* Including deficiency appropriation.

*b* Includes \$1,646.45 of the appropriation for reclamation of arid lands carried to the fiscal year 1882.

*c* Includes \$85.26 of the appropriation for reclamation of arid lands and \$3,530.85 of the appropriation for experiments in the manufacture of sugar, carried to the fiscal year 1883.

*d* Includes \$7,656.13 of the appropriation for reclamation of arid lands, carried to the fiscal year 1884.

*e* Includes \$93,192.27 of the appropriation for Bureau of Animal Industry and \$2,970.82 of the appropriation for quarantine stations, carried to the fiscal year 1886.

*f* For the fiscal year 1888 including the sum of \$8,000 appropriated for deficiencies in the appropriation for experiments in the manufacture of sugar for the fiscal years 1887 and 1888, of which \$7,927.50 was disbursed and \$72.50 remained unexpended.

*g* Includes \$12,923.25 of the appropriation for botanical investigations and \$58,364.76 of the appropriation for experiments in the manufacture of sugar, carried to the fiscal year 1890.

*h* Includes \$188,974.69 of the appropriation for Bureau of Animal Industry, carried to the fiscal year 1891.

*i* Includes \$7,891.94 for statutory salaries of the year 1894.

*j* For the years 1905 and 1906 the figures given represent payments made to close of June 30, 1906, the accounts for those years being still open at the date of this revision.

*k* This total is the amount actually appropriated for the various fiscal years, with the exception of \$37,604.70 appropriated July 13, 1868, to cover a number of expenditures made in previous years. It does not include an aggregate sum of \$369,344.48 reappropriated from the unexpended balances of several fiscal years. (See foregoing notes.)

*l* Does not include \$37,604.70 which was disbursed during several years, and covered by an appropriation of like amount, made July 13, 1868. (See note 5.)

*m* Does not include an aggregate sum of \$369,344.48 reappropriated from the unexpended balances of several fiscal years. (See foregoing notes.)

## REPORT OF THE EDITOR, DIVISION OF PUBLICATIONS.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF PUBLICATIONS,  
*Washington, D. C., September 1, 1906.*

SIR: I have the honor to submit herewith, for your information and consideration, a report on the work of this Division for the fiscal year ended June 30, 1906, together with recommendations in regard to future operations.

Respectfully,

GEO. WM. HILL,  
*Editor and Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

A steady increase in the work of this Division in all its branches has characterized the year just past. The number of publications of the year 1904 amounted to 972; in 1905 there were 1,072; in 1906, 1,171. In 1904 the new publications, exclusive of those issued from the Weather Bureau, for the editing of which this Division is not responsible, amounted to 379; in 1905 there were 391, and in 1906, 414. In the matter of reprints, still excluding the publications of the Weather Bureau, the figures are: For 1904, 514; for 1905, 596; and for 1906, 660. The number of printed pages in new publications issued during the year was 20,942, and in revised and reprinted matter 29,411—a grand total of 50,353 pages. The number of copies of publications of all classes printed during the year, including those of the Weather Bureau, was 13,488,527, an increase of 1,012,870 over the preceding year.

The earnest effort to reduce the size of publications and to restrict also the size of the editions issued continues to bear fruit. The total number of pages represented by the 414 new publications issued during 1906 is actually slightly under the number of pages in the 379 new publications issued in 1904. In this connection it is due to the editorial force to note that the number of pages contained in new publications, which is generally assumed to represent the sum of the work of our editors, is not a true indication; as all persons who have had practical experience with editing will readily understand, the reduced number of pages in the publications as they are actually printed represent considerably more work than if no reduction had taken place. The average edition of each publication in 1906 was 11,548, as against 11,637 in 1905—a comparatively insignificant reduction; but, as was pointed out in my last report, comparison with the average for the five years which ended with the fiscal year 1905 shows a considerable reduction.



One of the clearest indications of the increase in the work of the Division is shown by the number of requisitions for printing issued during the fiscal year. In 1904 the requisitions drawn on the main printing office amounted to 1,278, on the branch printing office, 3,446, a total of 4,724. In 1905 the requisitions drawn on the main office numbered 1,485, on the branch office, 3,654, a total of 5,139. In 1906 the requisitions drawn on the main office were 1,631, on the branch office, 4,502, a total of 6,133. These figures are exclusive of the printing work done for and at the Weather Bureau.

It would be natural to conclude that this great increase in the work of the Division, as shown by the number of requisitions, by the increased number of publications, and also by the growth of the work in the Document Section and in the Section of Illustrations, should have been accompanied by a corresponding increase in the total cost of performing the work. That this is far from being the case is made strikingly manifest by a comparison of the figures for 1904 and 1906. In 1904 the total appropriations available, exclusive of the general printing fund—which is applied in its entirety to work done at the Government Printing Office—amounted to \$229,320; the corresponding appropriations for 1906 were \$246,620, an increase of only  $7\frac{1}{2}$  per cent. On the other hand, as shown above, the increase in the number of requisitions, each representing, of course, a separate piece of work, was 30 per cent, and in the number of publications edited over 9 per cent, while there was also a very considerable increase, as will be shown later on in this report, in the work of the Document Section and the Section of Illustrations.

More striking evidence, it seems to me, could not be shown of the average efficiency of the force employed under my direction. It is not only a pleasure, but a duty, to call attention to this fact, inasmuch as I shall find it necessary in concluding this report to present to you, for your favorable consideration, an earnest appeal for more adequate appropriations and some tangible recognition of meritorious service by an advance in the scale of wages of the more responsible persons connected with the work of the Division and of those other members of the force to whose efforts the Government is indebted for this admirable showing.

#### ADDITIONAL WORK IMPOSED ON THE DIVISION.

Besides the large increase in the regular work of the Division, the year of 1906 has been marked by a very considerable amount of extra work. The preparation of special reports in reply to inquiries of the Joint Committee on Printing and of the Keap Commission has involved a large amount of labor, which has only been accomplished by frequent calls for extra work on the part of several of our employees. It gives me pleasure to record the fact that every appeal of this kind has been met not only promptly but cheerfully.

#### ADVISORY COMMITTEE ON PRINTING AND PUBLICATION.

By Executive order dated January 20, 1906, the President ordered that there be appointed in each of the Executive Departments an advisory committee on the subject of printing and binding, the chairman of such committee to be an Assistant Secretary or other

qualified official, and at least one member of the committee to have had practical experience in editing and printing. This order indicated in a general way the duties of such committee, under the direction of the head of the Department, and laid down certain general principles which should hereafter govern the form of the annual reports of the various bureaus and offices of the Departments. In accordance with such order, on January 23, 1906, you appointed such a committee, consisting of the following persons: W. M. Hays, Assistant Secretary, chairman; Willis L. Moore, Chief of Weather Bureau; and Geo. Wm. Hill, Department Editor, secretary. General Order No. 92, appointing this committee, recites the President's Executive order in full and will be found printed below:

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., January 23, 1906.*

GENERAL ORDER No. 92.

The President, under date of January 20, 1906, has issued the following Executive order:

"It is hereby ordered that there shall be appointed by the head of each of the Executive Departments an advisory committee on the subject of printing and publication. The chairman shall be an Assistant Secretary, or other qualified official, and at least one member of the committee shall have had practical experience in editing and printing.

"It shall be the duty of such committee, under direction of the head of the Department, to see that unnecessary matter is excluded from reports and publications; to see that copy is carefully edited before rather than after going to the Printing Office; to do away with the publication of unnecessary tables, and to require that statistical matter be published in condensed and intelligible form; to supervise the preparation of blank forms; to require the frequent revision of mailing lists; to prevent duplication of printing by different Bureaus; to exclude unnecessary illustrations from Department documents, and to prevent the printing of the maximum edition allowed by law, when a smaller edition will suffice; to recommend to the head of the Department, for inclusion in the recommendations contained in his annual reports, needed changes in the statutes governing Department publications.

"The following general principles shall hereafter govern the form of the annual reports of the various Bureaus and Offices of the Departments:

"(1) Annual reports shall be confined to concise accounts of work done and expenditures incurred during the period covered, with recommendations relating to the future, including plans for work to be undertaken.

"(2) Contributions to knowledge in the form of scientific treatises shall not be included in the annual reports.

"(3) Illustrations in annual reports shall be excluded, except (a) maps and diagrams indispensable to the understanding of the text; (b) views of monuments or important structures begun or erected; (c) views showing conditions in outlying possessions of the United States and relating to work done or recommendations made.

"(4) Inserted material, written or compiled by persons not connected with the reporting office, and biographical and eulogistical matter relating to the past or present personnel of the office, shall be excluded.

"(5) Reports of officers who do not report directly to the head of an Executive Department shall not be reported in the annual report of a Department, but where necessary shall be summarized in the reports of the officials to whom such officers do report.

"(6) Tables shall be inserted only when verbal summaries and statements of totals are inadequate, and complete texts of laws and court decisions shall, except in cases of great importance, be excluded.

"(7) Detailed descriptions and lists of methods, processes, purchases, bids, rejections, installations, repairs, specifications, and personnel employed shall be omitted except when required by their unusual importance or by statute."

In accordance, therefore, with the first clause of the above Executive order, the following are appointed an advisory committee on the subject of printing and publication:

W. M. HAYS, Assistant Secretary, chairman; WILLIS L. MOORE, Chief of the Weather Bureau; GEO. WM. HILL, Department Editor, who shall be secretary.

The attention of all chiefs and editorial assistants is called to the terms of the above Executive order, compliance with which is enjoined upon all persons submitting or supervising matter submitted for publication.

JAMES WILSON, *Secretary.*

The meetings of the committee have not been set for particular dates, but have been held from time to time, subject to the call of the chairman, upon submission by the Editor of matter calling for the action of the committee. The duties assigned to the committee by the terms of the President's order and the principles laid down therein as those which should govern the printing and binding work of the Department conform very closely to the duties heretofore assigned to this Division by the Secretary and the principles laid down for the guidance of the Department Editor in the Secretary's orders. This fact has greatly facilitated the work of the committee. The first meeting of the advisory committee was held in the office of the Department Editor February 19, 1906, and altogether up to the close of September the committee had held ten meetings.

#### COOPERATION IN THE PREPARATION OF MANUSCRIPTS.

It frequently happens that when a manuscript is submitted for publication certain portions thereof are found to relate to the work of some other Bureau, Division, or Office, and it has been the custom of this Division, by direction of the Secretary, to refer such portions to the office interested for approval. This course has been followed because it was necessary to prevent the publication by a Bureau of incorrect statements in regard to the work of another Bureau having particular supervision of that subject. Some of the Bureaus have for some time been cooperating in this way while the manuscript was in course of preparation, and the desirability of a general adoption of this plan led to the consideration of the subject by the advisory committee, and this committee, on June 26, 1906, promulgated the following recommendation, which, having been approved by the Secretary, has become the rule of the Department:

UNITED STATES DEPARTMENT OF AGRICULTURE,  
*Washington, D. C., June 26, 1906.*

#### RECOMMENDATION OF THE ADVISORY COMMITTEE ON PRINTING AND PUBLICATION OF A PLAN OF COOPERATION IN PUBLICATIONS BY THE DIFFERENT OFFICES OF THE DEPARTMENT.

When it is deemed necessary for one Bureau or Office to cover any part of the field of another Bureau or Office, the collaboration should be arranged for before the work is done. When, however, incidentally to the prosecution of an investigation, observations or experiments are made which are legitimately related to the special investigation and are essential to the published report, and yet properly fall in the field of another Bureau or Office, the following rules shall apply.

(1) Where it seems desirable to include in the publication of any Bureau or Office matter which comes within the field of another Bureau or Office, the notes or other memoranda which it is desired to use will be submitted to the Bureau or Office interested prior to or during the preparation of the bulletin or report, so that the desirability of their use in the publication intended may be passed upon; and if such use be deemed proper, they may be corrected and supplemented and, if of sufficient importance, incorporated as a direct contribution from the Bureau or Office in charge of the special field, conforming, however, to the plan and purpose of the publication. Full credit for the making of any new field notes or memoranda is to be given to the person making them. This applies more particularly to mere paragraphs or short notices.



(2) Where the matter is of sufficient extent and importance to warrant it, the portion contributed by the collaborating Bureau or Office may appear under the direct authorship of the expert of that Bureau or Office as a special chapter or report, incorporating, as before, the results of the field notes or records of the Bureau or Office issuing the publication, and giving full credit.

(3) Wherever the subject is of sufficient importance to warrant a separate publication by the collaborating Bureau or Office, such a separate publication is to be made.

(4) Wherever the subject has already been adequately covered by a publication of the collaborating Bureau or Office, so that the submitted notes are a mere repetition, such matter is either to be stricken out and a footnote or reference made to the publication of the Department in which the desired information is given, or a quotation or extract given.

NOTE.—It is understood that the special subjects of investigation of another Bureau or Office are not to be included in any publication of a related Bureau or Office except where the necessity is distinct and apparent. In other words, the arrangements above outlined are not to encourage the frequent and unnecessary digressions into the fields of other Bureaus and Offices, but rather to give such necessary references in cooperative publications the indorsement of the Bureau or Office in charge of the subject, and to make the latter fully responsible for all references in publications of the Department in its own special field of inquiry.

NOTE.—The aforesaid provisions shall not apply to the Experiment Station Record, Experiment Station Work, and Annual Report of the Office of Experiment Stations in so far as these are reviews of the work and publications of the agricultural colleges and experiment stations, nor to the publications of the experiment stations in Alaska, Hawaii, and Porto Rico, which are organized and conducted in essentially the same way as the State experiment stations.

W. M. HAYS,  
WILLIS L. MOORE,  
GEO. WM. HILL,

*Advisory Committee on Printing and Publication Work.*

Approved:

JAMES WILSON, *Secretary.*

Upon the adoption of this rule, all manuscripts are supposed to be submitted to this office with the approval, or, at least, bearing the initials upon those portions which may come within the scope of some other Bureau, Division, or Office. If the plan of cooperation recommended by the committee be strictly followed, the publication of a manuscript after it has been submitted will be greatly facilitated. The principal benefit to be derived, however, seems to be that which will come from the close cooperation between the various Bureaus, Divisions, and Offices whose work is sometimes very closely related.

#### AMENDMENTS TO LAW GOVERNING PRINTING AND BINDING.

As a result of the special investigation conducted by the Joint Committee on Printing of the House and Senate, several amendments to the law governing the printing and binding of Government publications have been adopted by Congress. One of these (Public—No. 13) provides that in the printing and binding of publications emanating from the Departments, the cost of which is now charged to the allotment for printing and binding for Congress, the cost of illustrations, composition, stereotyping, and other work involved in the actual preparation for printing, apart from the creation of the manuscript, shall be charged to the appropriation or allotment of appropriation for the printing and binding of the Department itself, the balance of the cost to be divided between the appropriation for printing and binding for Congress and that of the Executive Department in proportion to the number of copies furnished to each. Under the operations of this law, had the same been in force during the past year, the total additional amount chargeable to the appropriation

for printing and binding of this Department would have exceeded \$115,000. In spite of all the efforts made in the interests of economy, it did not seem possible, in view of the constantly increasing demands upon the Department for its publications, to suffer any portion of this increased expense to be chargeable to the regular appropriation; hence, it was necessary to ask for an increase in the appropriation for printing and binding for this Department sufficient to make the total at least equivalent to the appropriation for previous years plus the sum of \$115,000; and the current year's appropriations consequently provide the sum of \$300,000 for printing and binding for the Department of Agriculture. This, however, as the above explanation shows, is in no sense an increase in the appropriation.

A second resolution (Public—No. 14) provides that public documents and reports printed for Congress may be printed in two or more editions to meet the public requirements, and this provision applies also to the number authorized to be printed for any of the Executive Departments. It is provided that the aggregate of such editions shall not exceed the number of copies now authorized or which may be authorized. It is believed that this provision will prevent the accumulation of undistributed publications, which has been one of the evils of the past; but this provision will, in no sense, reduce the cost of printing of this Department, inasmuch as there has not been for many years any such accumulation of publications in the hands of the Department. On the contrary, the demand has invariably been found greater than the supply.

The resolutions above referred to are as follows:

(Public Resolution—No. 13.)

Joint resolution to correct abuses in the public printing and to provide for the allotment of cost of certain documents and reports.

*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,* That hereafter, in the printing and binding of documents or reports emanating from the Executive Departments, bureaus, and independent offices of the Government, the cost of which is now charged to the allotment for printing and binding for Congress, or to appropriations or allotments of appropriations other than those made to the Executive Departments, bureaus, or independent offices of the Government, the cost of illustrations, composition, stereotyping, and other work involved in the actual preparation for printing, apart from the creation of manuscript, shall be charged to the appropriation or allotment of appropriation for the printing and binding of the Department, bureau, or independent office of the Government in which such documents or reports originate; the balance of cost shall be charged to the allotment for printing and binding for Congress, and to the appropriation or allotment of appropriation of the Executive Department, bureau, or independent office of the Government, in proportion to the number delivered to each; the cost of any copies of such documents or reports distributed otherwise than through Congress, or the Executive Departments, bureaus, and independent offices of the Government, if such there be, shall be charged as heretofore: *Provided*, That on or before the first day of December in each fiscal year each Executive Department, bureau, or independent office of the Government to which an appropriation or allotment of appropriation for printing and binding is made, shall obtain from the Public Printer an estimate of the probable cost of all publications of such Department, bureau, or independent office now required by law to be printed, and so much thereof as would, under the terms of this resolution, be charged to the appropriation or allotment of appropriation of the Department, bureau, or independent office of the Government in which such publications originate, shall thereupon be set aside to be applied only to the printing and binding of such documents and reports, and shall not be available for any other purpose until all of such allotment of cost on account of such documents and reports shall have been fully paid.

This resolution shall be effective on and after July first, nineteen hundred and six.

Approved March 30, 1906.

## (Public Resolution—No. 14.)

Joint resolution to prevent unnecessary printing and binding and to correct evils in the present method of distribution of public documents.

*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled*, That the Joint Committee on Printing is hereby authorized and directed to establish rules and regulations, from time to time, which shall be observed by the Public Printer, whereby public documents and reports printed for Congress, or either House thereof, may be printed in two or more editions, instead of one, to meet the public requirements: *Provided*, That in no case shall the aggregate of said editions exceed the number of copies now authorized or which may hereafter be authorized: *And provided further*, That the number of copies of any public document or report now authorized to be printed or which may hereafter be authorized to be printed for any of the Executive Departments, or bureaus or branches thereof, or independent offices of the Government may be supplied in two or more editions, instead of one, upon a requisition on the Public Printer by the official head of such Department or independent office, but in no case shall the aggregate of said editions exceed the number of copies now authorized or which may hereafter be authorized: *Provided, further*, That nothing herein shall operate to obstruct the printing of the full number of any document or report, or the allotment of the full quota to Senators and Representatives, as now authorized, or which may hereafter be authorized, when a legitimate demand for the full complement is known to exist.

Approved March 30, 1906.

A further amendment to the law provides that only a single estimate shall be made by each Department in its printing and binding, and that after the expiration of the current fiscal year no appropriations other than those made specifically and solely for printing and binding shall be used for such purposes in any Executive Department or Government establishment in the District of Columbia.

This amendment is contained in the act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1907, and for other purposes (Public—No. 383), and is as follows:

SEC. 2. Hereafter there shall be submitted in the regular annual estimates to Congress under and as a part of the expenses for "Printing and binding," estimates for all printing and binding required by each of the Executive Departments, their bureaus and offices, and other Government establishments at Washington, District of Columbia, for each fiscal year; and after the fiscal year nineteen hundred and seven no appropriations other than those made specifically and solely for printing and binding shall be used for such purposes in any Executive Department or other Government establishment in the District of Columbia: *Provided*, That nothing in this section shall apply to stamped envelopes, or envelopes and articles of stationery other than letter heads and note heads printed in the course of manufacture.

Under this provision of law it will be absolutely necessary to provide for an increase in the appropriations for printing and binding of the Department apart from the necessity of providing for the natural growth of the printing work. In the appropriations made heretofore for the several bureaus and offices provision has not infrequently been made for printing, and when this has been the case it has been usual to call upon such bureaus and offices, whose appropriations permitted it, to pay for a share of their own printing. During the past year over \$22,000 was contributed by the various bureaus and offices to the expenses of printing and binding, equivalent to an increase of that amount in the appropriation for printing and binding. Hereafter, under the provision of law just cited, all such expenses must be met from the single appropriation for printing and binding. It has, moreover, become apparent during the first quarter of the current year that three of the principal Bureaus of the Department are going to be compelled to make unusual and very large calls upon the printing fund for the printing of books, blanks, forms, and other



distinctly administrative printing. These are the Bureau of Animal Industry, the Forest Service, and the Bureau of Chemistry, an enormous increase in the administrative work having devolved upon these Bureaus. All provision for such increased printing expenses must now be made in the general printing fund.

It also becomes necessary under this amendment to the law to include in the general estimates for printing and binding the appropriation heretofore separately provided for, for printing Farmers' Bulletins. Elsewhere this report has endeavored to explain the necessity for an increase in the provision for Farmers' Bulletins, so as to enable the Secretary, if possible, to restore the quotas of Senators and Representatives to its former figure, namely, 15,000 copies. The amount appropriated for the current year for this purpose is \$98,750. Were no increase whatever provided for in the sums allotted for printing over the current year it would still therefore be necessary to add \$121,000 to the \$300,000—the present printing fund—but, in view of the special demands upon the printing fund coming from the three Bureaus mentioned, and the necessity for increasing the supply of Farmers' Bulletins, I have found it necessary to estimate for \$450,000 at the least for the printing and binding for this Department for the ensuing year.

The change in the law by which the expenditures for printing and binding of this Department have to be included in a single item and eliminating appropriations for printing from any of the general appropriations for the work of the several Bureaus, suggests the possibility of carrying this reform still further. There seems to be no reason why the appropriation for printing and binding should not be included in the general appropriation bill for the Departmental expenses, instead of being made, as now, a part of the appropriation for the Government Printing Office. It is believed that by this means the keeping of accounts would be simplified and a considerable sum, forming a legitimate part of the regular expenses of the Department, could be more properly included as one of the items of its total expenses.

#### THE RESTRICTIONS TO GRATUITOUS DISTRIBUTION.

The continued and rapid increase in the demands made upon the Department for its publications has been far beyond its ability to supply. Every effort has been made to minimize the waste inseparably attendant upon a gratuitous distribution of documents, and every means has been adopted looking toward economy in our publication work; editions have been cut down, illustrations greatly reduced, and, with the assistance of the Public Printer, the mechanical work has been performed with the strictest regard to economy as far as this Office is able to control it. It does not seem possible to carry measures of economy any further in these directions. A system of free distribution, however carefully handled, is fraught with embarrassment to the distributing agency when the demand so greatly exceeds the supply, as has been the case of late years with the publications of this Department. Moreover, under these circumstances, great injustice is done to the very many persons who, by cooperation in some way with the Department in its work or as special correspondents, render to it some tangible service which rightly entitles them to

receive such of our publications as are likely to be of use to them. Under the system of distribution which has heretofore prevailed many persons having no claim whatever on the Department would receive from us, directly or indirectly, through some Senator or Representative, through whom requests are preferred, publications which we were unable to supply to later applicants having special claims upon our consideration. Accordingly, it was found absolutely necessary to effect a radical change in our system of distribution, and on April 14, 1906, you issued a general order restricting the distribution of the Department's publications other than Farmers' Bulletins or emergency circulars to "libraries, educational institutions, the press, State and foreign officials connected with agriculture, exchanges, and such persons as are rendering tangible service to the Department, either by active cooperation in its work or as special correspondents." Having provided for such distribution and, in addition, a small supply to be reserved for emergencies and for use in correspondence and to be placed in the hands of the Superintendent of Documents for sale, further reprints are prohibited, leaving such as may be necessary to supply later applicants to be furnished by the Superintendent of Documents, who, under the law, is authorized to reprint, with the approval of the Secretary, any publication of the Department, and reimburse himself from the proceeds of his sales. Mailing lists of all Offices and Divisions were ordered revised in accordance with the new plan of distribution.

The list of publications continues to be issued monthly and is, as heretofore, sent to everyone applying for publications. This list indicates to applicants what publications are issued for free distribution and what must be obtained by purchase from the Superintendent of Documents, and at what price. A similar list is prepared for use in foreign countries, the required postage being indicated in addition to the price of the publication. The total edition of the monthly list now exceeds 200,000 copies.

The general order above referred to is as follows:

GENERAL ORDER NO. 96.

APRIL 14, 1906.

REVISION OF MAILING LISTS AND RESTRICTIONS OF GRATUITOUS DISTRIBUTION OF PUBLICATIONS.

In view of the restrictions placed on the funds available for printing and binding for this Department, and in view of the constantly increasing demands upon these funds, it becomes necessary to adopt restrictive measures in regard to the issue of publications. It is quite as incumbent upon the Department to publish the information it has acquired as to conduct the laboratory work and field and other investigations by which this information is obtained. The only limit placed upon the acquisition or diffusion of this information is that it shall be of value to agriculture. Four ways only seem available by which the expense of the printing and binding for this Department may be judiciously restricted: First, by prevention of the waste inevitably accompanying a general gratuitous distribution; secondly, by careful editing (in the manuscript) of every document submitted for publication, with a view to presenting the facts in the briefest, most succinct style compatible with clearness; thirdly, by rigid suppression of the tendency to reedit in the proof; and, fourthly, by restriction of illustrations to such as are absolutely necessary. General orders have already been issued enforcing the second, third, and fourth conditions, and it is only necessary here to reiterate them with added emphasis.

To carry out the first condition it is ordered that hereafter the first edition of every publication shall be limited to such number as is necessary to supply libraries, educational institutions, the press, State and foreign officials connected with agriculture, exchanges, and such persons as are rendering tangible service to the Department,

either by active cooperation in its work or as special correspondents, and, in addition, a small number to be reserved for emergencies and for use in correspondence, and to furnish a small supply to be placed in the hands of the Superintendent of Documents for sale. Hereafter all reprints shall be confined to such numbers as may be necessary to replenish the supply of the Superintendent of Documents, where the demand for the same, at a price fixed by the Public Printer, continues.

Chiefs of Bureaus, Offices, and Divisions maintaining free mailing lists will cause the same to be rigidly revised in accordance with the distribution indicated above.

This order does not apply to Farmers' Bulletins or to emergency circulars.

JAMES WILSON, *Secretary*.

#### FARMERS' BULLETINS.

The total number of Farmers' Bulletins printed during the last fiscal year was 437, of which 404 were reprints, numbering 5,693,000 copies, and 33 were new publications, numbering 875,000 copies—6,568,000 copies in all. The Congressional distribution was by far the largest we have known, notwithstanding the fact that the quota allotted to Members was less by 1,000 copies than the year previous. This had been made necessary by the considerable reduction in the number of bulletins carried forward from the year 1905, but the reduction in the number carried forward at the close of 1906 was very marked, the balance carried over being barely sufficient to supply each Senator and Representative with 1,000 copies, and it is only by withdrawing from Senators and Representatives the right of selection and making an arbitrary distribution, which we have always endeavored to avoid, that we have been enabled to do this. Congress having made no provision for an increase in the appropriation for Farmers' Bulletins for the current year, it has therefore become necessary to greatly reduce the quota of Senators and Representatives for the current year, and whereas in 1905 that quota was 15,000 and in 1906 14,000, it will be impossible to provide Members with more than 10,000 each for this year. This condition of things has come about very naturally as the result of an increased demand among Senators and Representatives for these bulletins, unaccompanied by any increase in the appropriation for providing them. The law provided that 80 per cent of the bulletins printed shall be for the use of Senators and Representatives, one-fifth only being reserved for the use of the Department; but in former years it was very common for many Members to refrain from drawing their quotas, and the accumulation thus left in the hands of the Secretary was invariably added to the Congressional allotment for the ensuing year. At the present time there are very few Congressmen who do not utilize their own quotas, and among those who do not it is usual to transfer their quotas to some of their colleagues. In this way the whole year's supply has been practically exhausted and none remains to be added to the following year's Congressional supply. Under these circumstances it seems necessary to call for an increase in the amount appropriated for the printing of Farmers' Bulletins; but, as explained elsewhere, under recent amendments of the law it is no longer permissible to appropriate for this or any other purpose involving printing and binding in a special appropriation, and the necessary appropriations for Farmers' Bulletins will have to be included in the general estimate for printing and binding for the ensuing year.



## THE WORK OF THE EDITORS.

The development of editorial sections in several of the Bureaus, Divisions, and Offices of the Department seems to call for some special reference to the work of our own editors and to the editorial duties and responsibilities imposed on this Division. The mere statement of the fact that there were edited in the Division during the past year 414 new publications, aggregating, in round numbers, 21,000 pages of matter, emphasizes the impossibility of the Department Editor's giving his personal attention to each publication, burdened, as he is, moreover, with the general direction of the administrative work of a Division numbering 160 persons and controlling expenditures aggregating over \$400,000 yearly; yet some means had to be found of so conducting the work as to hold him still responsible to the Secretary for all published matter emanating from the Department. Upon the submission of any manuscript for publication a record is at once made in the Editorial Section and the manuscript is handed to one of the assistant editors for reading and preparation for the printer. This reader is responsible for calling to the attention of the associate editor any matter of importance sufficient to suggest change or elimination or modification of any sort, or even any matter of special importance, whether calling for modification or not. The manuscripts having been so read and properly marked, are then submitted for revision to the associate editor, and sometimes to the assistant chief of the Division, and they are not infrequently the subject of consultation between these gentlemen. All matters not deemed of sufficient importance for the personal attention of the Editor having been eliminated in this revision, the manuscript finds its way to the desk of the Editor and Chief, where a final revision takes place. As a result of this final revision the manuscript is either forwarded to the printer or referred back to the Chief of the Bureau from which it was received, with suggestions of amendments or other changes; or it may be reserved for submission to the advisory committee on printing or, in some cases, directly to the Secretary. The increase of work which has necessitated this method of procedure has necessarily thrown upon my assistants in the editorial work a large increase of responsibility, and the success which has attended the work conducted in this manner speaks well for the good judgment, tact, and trained minds of those engaged in it. The main objects kept in view in the editorial work of the Division are the publication of nothing which might not meet with the full approval of the Secretary and the communication to him of all matter demanding his personal attention; to change the manuscript submitted as little as possible consistent with the requirements of departmental policy and of clear utterance, good English, and the final appearance of each publication in as good form and style as the appropriations available for the purpose will permit. No little credit is due to the editorial force for the fact that the increase in the publication work between the fiscal years of 1904 and 1906 was made without any increase in the general appropriation for printing and binding and in the sum allotted for the printing of Farmers' Bulletins. To the Government Printing Office also belongs considerable credit.

## EDITORIAL WORK IN THE VARIOUS BUREAUS AND OFFICES.

Reference to our own editorial work would be incomplete without consideration of the editorial work performed in the various Bureaus and offices. Originally all the persons engaged in editing manuscripts for publication were employed in this Division and the relations of this Division in regard to publication work were directly with the several Chiefs, each of whom, in those days, was presumed to, and doubtless did, review all matter prepared for publication in his own Bureau. As the work in the several Bureaus increased, however, many of the Chiefs found it impossible to personally review all such matter, notwithstanding the fact that no matter is passed in the Division of Publications unless it is accompanied by the personal indorsement of the Chief in a letter of transmittal. For the Chief's own protection it became necessary, therefore, that some one should serve as his reader, performing for him a service analagous to that performed for the Secretary by the Department Editor. For such a purpose it was desirable to have a person familiar with the work of the Bureau in which he was engaged and who should also be thoroughly familiar with the views of his Chief. This necessity led to the appointment in several of the Bureaus and Offices of editorial clerks or editorial assistants. It was believed that in addition to performing the service indicated for their Chief such editorial assistants could greatly relieve this Division by familiarizing themselves with its requirements and preparing manuscript in harmony therewith. In this belief this Division favored such appointments, it being generally understood, as the writer assumed, that these editorial assistants should be regarded as detailed from this Office and that they would do practically the same work as they would do here, except that their efforts would be confined to the publications of one particular Bureau or Office. Most frequently, however, such is not the case. Experience has demonstrated that, however helpful these editorial assistants may be to their own chiefs, they have not, as a rule, relieved this Division of any of its necessary editorial work, and many of them, as a rule, direct their energies to preparing copy for the printer, not according to the views of this Office, but according to their own views. When this occurs the employment of such editorial assistants merely adds to the work of this Division instead of relieving it. Where these clerks are animated by this spirit of independence it would be far better were they to confine themselves exclusively to the task of reading manuscript for their respective Chiefs and to such editing of manuscript as might be necessary to bring the same into harmony with the views of the Chiefs and to the verification of all statements made therein, leaving matters of form, style, proof reading, etc., to this Office. It is proper to state that in a few cases this is done and the results are found eminently satisfactory.

In this connection it may be well to reprint the order of the Secretary issued October 18, 1905, as follows:

## TO THE CHIEFS OF BUREAUS, DIVISIONS, AND OFFICES:

It is my earnest desire, and I have so instructed the Department Editor, that the fullest consideration should be given to economy as regards style of Department publications, including typography, paper, illustrations, number of copies printed, binding,

etc. Editions must be limited in size to a small number in excess of what is required for immediate distribution. This order is issued for the information of all chiefs who may submit matter for publication and with the view of facilitating the work of the Editor in keeping down the expense of printing.

JAMES WILSON, *Secretary*.

#### GENERAL INDEX TO DEPARTMENT PUBLICATIONS.

The organization in the Division of Publications of an indexing section was recorded in my last report, together with some of the more important reasons that made the compilation of a general index of all the Department's publications a matter of grave interest. Indeed, the necessity of a complete system of indexing of the publications of a Department issuing so many bulletins and reports as this is so manifest that it hardly seems to call for argument or for supporting evidence. Although the very limited force I was enabled to place at the disposal of the assistant in charge has necessarily kept the work done within comparatively narrow limits, enough has been accomplished to forcibly emphasize its utility.

Two indexes are in course of preparation in this section. One is intended to furnish a full list of references on all important agricultural subjects and the publications of the Department that are available for distribution. This index now consists of about 15,000 cards, and contains references to most of the available publications of the Department with the exception of the Yearbooks, special bureau reports, and annual reports issued prior to July 1, 1905. Every publication issued since that date has been indexed for it and considerable work has been done on the earlier publications. A method has been devised by which cards representing any publication indexed can be promptly withdrawn from the index as soon as the publication ceases to be available. The maintenance of this index and the proper application of this method should be of great service to the clerks sending out publications in response to applications, by enabling them readily to determine whether any particular publication is available for distribution.

The second index is designed to give, when completed, a reference to every important statement on any topic of interest in farming methods and agricultural investigations occurring anywhere in any of the Department's publications. It includes at this writing about 10,000 cards. All of the Department's publications issued since August 1, 1905, have been indexed for it, and it also includes numerous entries added from the earlier Yearbooks. As rapidly as possible the entries for this index will be carried back to the earlier books issued by the Department and by the agricultural section in the Patent Office, of which this Department was originally a part. These card indexes are both kept in duplicate. The latter will be of special service to the editorial force of this Division. A number of indexes of special publications have also been prepared in this section, such as the index to the 1905 Annual Report and to the 1905 Yearbook and other bulletins.

A digest of the pure-food laws was prepared in this section for the Bureau of Chemistry, and forms Part 9 of Bulletin No. 69 of that Bureau. It is gratifying to state that the work received the warm commendation of the interested officials of the Bureau of Chemistry. This section was engaged for about two weeks in the month of May



last in the preparation of an index of the names and positions of Department employees for use in connection with a Congressional inquiry. In this work the Document Section cooperated. In addition to strictly indexing the work, the assistant in charge has performed considerable other work of a miscellaneous character, including the revision and bringing up to date of an historical sketch of the Department and the revision of Documents 179 and 247 of this Division, being the list of publications in the hands of the Superintendent of Documents for sale and a list of those that are published for gratuitous distribution. He also has charge of the preparation of the Monthly List of Publications.

It is my earnest hope that the additional editorial assistance asked for will permit the detail, for at least a considerable part of his time, of one of the editorial clerks to work in the Indexing Section. It is of the utmost importance that the indexes already undertaken be pushed to completion, and besides the ordinary work of the section for 1906 and 1907 there should be prepared the five years' index of the Yearbooks and an index of the first 250 Farmers' Bulletins. A revision of Circular 1 of this Division and of the Documents 179 and 247, referred to above, is called for yearly.

#### DOCUMENT SECTION.

The Document Section receives, distributes, and stores all the publications of the United States Department of Agriculture (except those of the Weather Bureau), and conducts all the correspondence and other clerical work incident to that distribution; but this brief, yet comprehensive, statement conveys but little idea of the manual and clerical work included in its activities.

As the publications of the Department consist of two great classes, namely, the Farmers' Bulletins and the miscellaneous publications other than Farmers' Bulletins (the latter including annual reports, yearbooks, bulletins, circulars, etc.), the work of the Document Section naturally falls along two lines, and as it has been found impracticable to conduct the distribution of these two classes of publications with the same working force, each class of publications is received in and distributed from a separate folding room, but the work attending this distribution is finally summarized and brought together in the hands of two competent bookkeepers, one for each class, in the office of the Assistant in Charge.

In addition to these folding rooms, where only the manual work is performed, the clerical work involved in correspondence and in the making and filing of orders is divided into two parts and assigned to two different forces, under the supervision of the Assistant in the Document Section and the document clerk, but in these offices requests and orders for both classes of publications are treated. As a part of the distribution work, but not connected with the correspondence or order work, two other forces are employed in addressing franks and envelopes for the mailing of publications to lists of correspondents and others, kept in and furnished by the different Bureaus, Offices, and Divisions of the Department. In one of these subsections clerical work is performed, and in the other addressing machines and folding machines are employed.

At the head of the whole force, and in close touch with each of the activities above mentioned, is the Assistant in Charge of the Document Section, with bookkeepers, order clerks, file clerks, and stenographers, under whose immediate supervision the replies and orders incidental to compliance with the requests of Congressmen and others whose official position entitles them to special attention are prepared. In conducting this correspondence, 32,998 letters, dictated and typewritten or carefully prepared with the pen, were sent out. Of these, 829 were for the signature of the Secretary and 32,169 for the signature of either the Chief of the Division of Publications or the Assistant in Charge of the Document Section. This correspondence was in addition to 246,949 letters received and attended to in the order room and replied to by means of blanks signed by the facsimile of the Chief of the Division and filled up with the necessary data by the clerks in the record room.

## DISTRIBUTION.

Of miscellaneous publications, there were on hand on the 1st day of July, 1905, 979,891 books or pamphlets, and there were received from the Public Printer between July 1, 1905, and June 30, 1906, both inclusive, 5,921,750 similar publications, making a total supply of miscellaneous publications amounting to 6,901,641. Of these, 5,939,307 were distributed in compliance with requests from Senators, Representatives, and Delegates, and miscellaneous applicants addressing themselves directly to the Department, and upon orders from the heads of the different Bureaus, Offices, and Divisions of the Department, leaving a balance of 962,334 miscellaneous publications on hand at the close of business June 30, 1906.

Of the Farmers' Bulletins there were in stock July 1, 1905, 1,416,499 copies, and during the year ended June 30, 1906, 6,763,299 copies were received from the Public Printer, making a total supply of 8,179,808. Of this number, there were distributed upon Congressional requests, from the quotas reserved for distribution under their franks, 5,279,476, and to miscellaneous applicants who applied directly to the Department 2,228,945 Farmers' Bulletins were mailed, or a total of 7,508,421, leaving a balance of 671,377 at the close of business June 30, 1906. To handle these 13,447,728 publications required an immense amount of purely manual labor, in receiving, storing, folding, or wrapping, sacking, and delivering to the post-office or to the offices of Senators, Representatives, and Delegates, in addition to which work over 5,000,000 franks were pasted on packages containing the documents. This manual work, however, although in itself fully occupying the working hours of 50 employees, was not equal in amount to the clerical labor involved.

## CLERICAL WORK.

It must be remembered that these nearly 13½ million documents could not be sent out indiscriminately, without proper authority or an appropriate record of their distribution. In the first place, account must be kept with the Public Printer for each and every separate report, bulletin, and circular, and then again it is necessary to keep an account with the stock room for each different publication.

Besides which, at the beginning of each fiscal year an account is opened with each Senator, Representative, and Delegate, crediting him with the number of Farmers' Bulletins allotted to him for distribution during the year, and charging to him every Farmers' Bulletin or other publication sent out upon his request.

Indexes and records must be kept of these orders, charges must be made from them upon their return from the folding room marked satisfied, and after the documents which they authorize have been entered as mailed, the orders themselves must be filed in numerical order for future reference as authority for the action taken, and as evidence in case there is any question as to the work having been properly performed. It has also been found necessary, in order to quickly refer to these files, that a card index should be kept of every order in the name of the person to whom the books were sent.

In addition to this work, which involves the writing of the address of the applicant at least three times, there were prepared in the two addressing rooms above mentioned over 4,500,000 addressed franks or envelopes for the mailing of Crop Reporters, Monthly Lists, Circulars, and Press Notices, sent out by request of the chiefs of the different Divisions, the document section having been designated by the Secretary as the proper office to prepare all the franks and addresses used in the mailing of publications.

Referring to the fact that over a quarter of a million miscellaneous requests were received in the document section during the last fiscal year, I desire to say that these requests are often expressed in an indefinite and vague way, merely suggesting the lines along which the writer's needs exist, and that to translate those requests into definite orders, intelligible to the laborers in the folding rooms, necessitates a corps of clerks thoroughly familiar with not only the titles of the publications of the Department of Agriculture, but with the subjects treated in them, in detail. This work, as far as it applies to Congressional requests, is performed in the office of the Assistant in Charge; but as it is quite impossible that he could do all of it the miscellaneous requests were, to the number of a quarter of a million, turned over to the document clerk, in charge of a specially trained and a thoroughly efficient corps of clerks, in order that the most-humble seeker after information who applied to the United States Department of Agriculture might receive definite and, if possible, full information on the subjects of interest to him.

But the requests coming into the Document Section, while largely referring to this Department's publications, are by no means confined to them, and it has been found absolutely essential to a full and satisfactory reply to the correspondence received in this office that both the Assistant in Charge and the document clerk should have a wide and at the same time accurate knowledge of all Government publications, and as far as possible be familiar with agricultural literature in general. Of course, when a request was of a character that required technical information to be given in a special letter, the communication has been referred to the Chief of the Bureau, Office, or Division under whose jurisdiction those matters are, but in a large majority of the cases they are simply requests for printed information along some line of investigation which has been conducted by the Department.



## INDEXING AND REGISTRATION.

For several years it has been the practice of the Department to forward by registered mail all copies of its yearbooks, annual reports of the Bureau of Animal Industry, Office of Experiment Stations, etc., and other costly publications. To accomplish this with the least amount of labor arrangements were made with the post-office, which greatly simplified the ordinary registration of individual packages, but at the same time it requires three times the clerical work to prepare a list of books for registration that it does to send them out in the ordinary way. Of such packages, 45,838 were forwarded during the last fiscal year, and a card index was kept showing the name and address of each person to whom such a package was mailed, in order that duplication to any one person might be prevented. This extra labor has been shown to be a source of great saving of publications, as by that means over 6,000 different books were withheld which otherwise would have been mailed, because that many persons were on more than one of the divisional lists of the Department as correspondents serving the Department, or, having received one copy and made some disposition of it, turned to the Department for another copy.

## EMPLOYEES.

The force of the Document Section during the past year has averaged about 120 persons. At one time during the early spring, owing to the extra work entailed by the rush made to get out Farmers' Bulletins allotted to Senators, Representatives, and Delegates, it was found necessary to employ ten or a dozen additional laborers. The administrative and supervisory work was performed by the Assistant in Charge, aided by his assistant, the document clerk, the heads of the addressing rooms, and the foremen in charge of the two folding rooms. Each of these has shown a commendable loyalty to the office, devotion to duty, and efficient service, but the task they have performed could not have been completed had they not received most efficient and well-directed assistance from the clerks and other employees, who, by their personal qualifications and their long service, have become experts in the work to which they are assigned. But even this force could not have so successfully performed the increased work without any increase in force had it not been for the well considered and effective system which has been rigidly enforced, causing all parts of the work to move smoothly and without friction.

## ACCOMMODATIONS.

In his efforts to perfect and carry out the system controlling the activities of the Document Section, the Assistant in Charge has been greatly aided by the conditions which exist in the new building, which was provided for the Document Section at the beginning of the calendar year 1905, and whose arrangements and facilities are most admirably suited to the work conducted there. Great relief has been afforded the laborers by the adoption of electric folding machines, by means of which the Monthly Lists, press notices, and other four-page circulars are folded ready for the envelopes, and the clerical work of the addressing of envelopes has been greatly lessened by the use of addressing machines.

## RECOMMENDATIONS.

Experience during the last six months with the folding and addressing machines convinces me of their thorough efficiency and great usefulness in the work of the Document Section, and I respectfully recommend that in your estimates for the next fiscal year there be provision for increasing those facilities, both in larger equipment and additional force.

It is not necessary to call your attention to the fact that the force in the Document Section receives inadequate pay for the work required and performed. Whatever may have been the circumstances which are responsible for this unsatisfactory condition, it is nevertheless to be deplored.

In executive and administrative work the supervision of the Document Section and of the various subsections therein calls for no mean order of ability, and yet, with the exception of the Assistant in Charge, no salary higher than that of a second-grade clerk is provided. The stenographic and correspondence work is laborious and exacting, yet the highest salary among the stenographers and clerks is that of a \$1,000 clerk. The bookkeeping, indexing, and other similar work is of a character equal to the work in any large shipping establishment, and yet the highest salary paid for that class of work is not greater than \$900. There are other employees in the Document Section who are satisfactorily performing duties that require characteristics and ability which should command much higher salaries and to fit a person to perform which would require months of arduous service, yet those individuals are receiving salaries averaging \$720 a year. I respectfully recommend, therefore, that in the estimates for the appropriation for your Department for the fiscal year beginning July 1, 1907, ample provision be made for the promotion to adequate salaries of those employees in the Document Section whose work may be found measurably equal to other Government employees now receiving much larger compensation.

## SECTION OF ILLUSTRATIONS.

The duty of the Section of Illustrations and Photography is to make and prepare for reproduction the drawings used to illustrate the numerous reports of the Department. Drawings, paintings, and sketches are also prepared which are not intended for publication, but for the purpose of a permanent record of some phase in the life history of plants or animals, and to serve as part of the working plant or equipment of the Bureau or Office in which they are kept.

Photographs are made from the numerous specimens received by the different Bureaus of plant or animal life; the plates and films sent in by the employees of the Department, taken by them while conducting their field experiments, are developed; enlarged prints and lantern slides for Farmers' Institute work and lectures, and also prints for the draftsmen to facilitate their work, are prepared. The negatives representing the work of the different Bureaus of the Department are filed by card index. Field photography was done during the months of July, August, and September by the assistant in charge of this section. There is a constant and increasing demand on this office to

help in photography of this kind, which should be encouraged as far as our facilities will permit.

This section also cares for all the original cuts, between 20,000 and 30,000, and drawings used in the Department's publications. These are carefully classified that they may be accessible for reprints, and also to meet the many requests from persons outside the Department, mainly representing magazines and journals.

#### STATISTICS OF THE WORK.

The number of employees in this section is eleven—the assistant in charge, four draftsmen, two assistant photographers, three clerks, and one messenger. During the fiscal year ending June 30 this office prepared and made 954 drawings. These drawings embrace practically every medium used in preparing drawings for the different reproductive processes used by this Department. The work in this section, owing to its varied character, requires draftsmen of a high order of skill and experience, frequently calling for the greatest ingenuity on their part. The work done during the year included maps 10 feet in length, made up from data furnished by engineers, such work occupying the time of a draftsman from six weeks to two months. This class of work is of the most exacting character, and when it is considered that there are but four draftsmen at my disposal the amount of work accomplished is most commendable.

What is said of the drawings may well be repeated regarding the photographic work. This work has practically outgrown its present quarters. The demands are increasing every day. With but two assistant photographers, the assistant in charge of the Illustration Section has to devote at least one-half his time to the actual doing of photographic work. His services would be more valuable were he employed in supervising and directing generally the work of the section, and I sincerely trust that the funds appropriated for the use of this Division may permit such an arrangement next year.

The whole number of new illustrations appearing in the publications of the year was 1,764. A detailed statement of the photographic work and of the work of our draftsmen will be found below. The great increase in the photographic work is especially marked. Its development is due to two principal causes: (1) It has been found possible, owing to the advance made in the art of photography, to very largely supplement the work of our draftsmen thereby and thus accomplish very much larger results by the aid of photography; and (2) other Bureaus and Divisions are manifesting a disposition to avail themselves more and more of the services of the central studio in this Division. Very many of them have no equipment for work of this character beyond the possession of several cameras, and depend largely upon this Division for development and printing of their negatives. Others better equipped are nevertheless lacking some of the more important and expensive apparatus, only one or two of them indeed being sufficiently well equipped to do all the photographic work they require. It is obviously undesirable to increase the installation and equipment of costly apparatus for occasional service in this, that, or the other Bureau when the same has been, or can be procured for this Division, where it will be available for the work of the whole Department. In most of the other Bureaus it is deemed



advisable to retain a certain amount of the photographic work in their own hands, but very few of them show a disposition to increase their facilities for this work, while by far the larger number seem to fully concur in the opinion that the bulk of the work can better be done here. A recent careful census of the photographic work done in the different Bureaus, Divisions, and Offices of the Department shows \$22,084.36 invested in photographic equipment, \$11,510 paid annually for photographic services, and \$8,111.58 paid for material. Of these large sums, the cameras and photographic equipment of this Division cost less than \$3,000; \$3,150 was paid for services in the studio, and less than \$500 for material. It is obvious from this statement that the transfer of a considerable portion of the work done in the other Bureaus to this Division will entail a very large increase in our work. I believe it to be equally obvious that in the interests of efficiency and economy such a transfer should be encouraged. It is of the utmost importance, therefore, that steps should be taken to enable us to meet the increase in this line of our work.

The quarters at present assigned to the Section of Illustrations are not only ill-adapted to the purpose, but are altogether too restricted, even for our present work, to say nothing of the probabilities of a considerable increase, as above outlined. It is earnestly hoped that suitable accommodations may be found for this section of our work in some portion of the new building now approaching completion, and the suggestion is made that much time and a very considerable amount of money can be saved were such provision to be made and the portion of the building set aside for our use, fitted for the work, while the building is still in the course of construction.

While the equipment and facilities in our present quarters are as good as these quarters will allow, it must be understood that they are by no means ideal, or even adequate.

Some provision will have to be made in the near future for an increase in our small force of draftsmen and photographers to enable us to meet the increasing demand for our services. The photographic work is as varied and exacting as that of the draftsmen, and demands assistants of a high order of skill and experience, who must be qualified to do all classes of photographic work.

The following is a detailed statement of the work done by this section:

#### PHOTOGRAPHIC WORK.

Negatives made.....	1, 012
Films and negatives developed.....	1, 528
Velox prints made.....	6, 233
Albuma prints.....	5, 192
Lantern slides made.....	576
Bromide enlargements.....	209
Prints mounted.....	1, 058
Repo. prints, base for pen drawings.....	172
Blocking and retouching negatives.....	161
Platinum prints.....	8
Blue prints.....	1, 218
Black prints.....	192

#### DRAWINGS.

Drawings made.....	954
Requests received for duplicate electros.....	165
Duplicate electros furnished to correspondents on request.....	1, 506
Requisitions and authorizations.....	93
Illustrations printed or published, not including reprints.....	1, 764

## EXPENDITURES.

For photo and artists' supplies.....	\$882. 88
For 73 engravings and electros.....	53. 72
	<hr/>
	936. 60

## THE BRANCH PRINTING OFFICE.

The branch printing office continues to be an indispensable adjunct to the Department. Some time ago the question of abolishing it was under consideration by the Public Printer, the object being to consolidate it with the main office. The project was, however, abandoned by him, but authority was conferred by Congress upon the Joint Committee on Printing to investigate and report upon the necessity for the continuance of the branch printing offices maintained in the Executive Departments. In accordance with the recommendation of the commission, it has been decided to send to the branch office here only work of a confidential character or urgently needed for immediate use, with just enough other work to keep the force employed.

The branch office is utilized for the numerous blanks, letter heads, circulars, crop cards, etc., which are for immediate use, and which are, as a rule, printed the same day the order is received—a convenience which could not possibly be enjoyed if such work were done at the main office. As an illustration of the very great value of the branch office, its work in printing the monthly crop cards may be cited. The copy for these cards is received at 12 o'clock on the 10th day of each month and 77,000 copies are printed and mailed before 4.30 the same afternoon. Emergency circulars and letters are often printed the same day as received. In the opinion of every Bureau, Division, and Office, the branch printing office is an absolute necessity, and its removal would result in incalculable inconvenience and delay in the work of the Department. It is earnestly hoped that the branch office may be allowed to remain and that as soon as possible more commodious quarters may be provided. The enormous amount of work done in this office, as shown hereafter, is evidence of the necessity of its existence, and I desire to bear testimony to the excellence of the work, the efficiency of the force, and the cheerful cooperation of the foreman in charge of the branch office.

The further consideration of the advisability of discontinuing the branch printing office is authorized by section 3 of the act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1907, which is as follows:

SEC. 3. The authority vested in the Joint Commission to examine into the general subject of the public printing and binding of Congress and the various Executive Departments, authorized and appointed under the provisions of the act making appropriations to supply deficiencies, approved March third, nineteen hundred and five, shall be continued in force during the term of the Fifty-ninth Congress, and the said Commission is hereby directed to continue its investigations and report to Congress at its next session. And the said Commission is hereby directed to inquire into the necessity for the continuance of the various branch printing offices and printing offices maintained in the various Executive Department bureaus or independent offices of the Government and to report what economies, if any, would be effected in the abolition of these printing offices or branch printing offices and the execution of the work now performed therein in the Government Printing Office.

This Division is firmly of the opinion that this Department is obliged to have a branch printing office for the expeditious printing of its numerous emergency circulars, decisions, and regulations, and of the very large number of blanks, letter heads, envelopes, etc., that are required in its work. It is not believed that any other branch printing office in the Executive Departments does as much work in proportion to its size and accommodations as the branch in this Department, and its abolition would be little less than a calamity.

The following is a condensed statement showing the work done in the branch printing office during the last fiscal year:

*Total work done in the branch printing office, 1906.*

Envelopes.....	2, 543, 867
Letter heads and note heads.....	1, 576, 150
Cards.....	3, 903, 153
Circulars.....	750, 339
Blanks.....	6, 492, 659
Labels and shipping tags.....	587, 286
Franks.....	1, 968, 925
Monthly and other lists.....	1, 583, 571
Crop Reporter (reprints).....	600
Circular letters and other notices.....	629, 675
Miscellaneous.....	2, 718, 687
Total number of pieces, 1906.....	22, 754, 912
Number of pieces of work, 1905.....	20, 387, 803
Increase.....	2, 367, 109
Number of requisitions, 1906.....	4, 502
Number of requisitions, 1905.....	3, 654
Increase.....	848

The following composition was done in the branch printing office:

1 edition of the Crop Reporter.....	14 quarto pages.
11 editions of the Crop Reporter.....	8 quarto pages each.
1 supplement to the Crop Reporter.....	8 quarto pages.
4 editions of the Monthly List.....	4 octavo pages each.
1 circular letter, 4 pages.....	8 by 10½ inches.

ORDERS RELATING TO PUBLICATION WORK.

The following general orders relating to the publication work of the Department were issued during the year in addition to those heretofore given:

GENERAL ORDER	UNITED STATES DEPARTMENT OF AGRICULTURE, OFFICE OF THE SECRETARY, Washington, D. C., December 6, 1905.
No. 90.	

To the CHIEFS OF BUREAUS, DIVISIONS, AND OFFICES:

Section 87 of the act governing the Government printing and binding, approved January 12, 1895, reads as follows:

"All printing, binding, and blank books for the Senate or House of Representatives and for the Executive and Judicial Departments shall be done at the Government Printing Office, except in cases otherwise provided by law."

And in the interpretation put upon this section by the Public Printer and by the Comptroller of the Treasury, embossing letter heads is covered by the word "printing," and the restriction imposed by this section applies to all letter heads, whether embossed or otherwise. Work of this character must, therefore, henceforth be ordered like other printing, through the Division of Publications, and, in view of the additional expense involved by embossing, instructions have been given to the chief of that division to honor no requisitions for embossed letter heads or envelopes.

JAMES WILSON, *Secretary.*



GENERAL ORDER }  
No. 97. }

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., April 16, 1906.

ORDER RESPECTING THE DESIGNATION OF THE TYPE SPECIES OF NEW GENERA.

In conformity with the practice of zoologists and botanists of this Department, it is hereby ordered that in all descriptions of new genera of plants and animals appearing in publications of the Department, whether proposed by employees or outside contributors, the type species of each new genus shall be designated.

W. M. HAYS,  
*Acting Secretary of Agriculture.*

RECOMMENDATIONS.

AMENDMENT TO PRINTING LAW.

Section 52 of the act providing for the public printing and binding and the distribution of public documents, approved January 12, 1895, reads as follows:

The Public Printer shall sell, under such regulations as the Joint Committee on Printing may prescribe, to any person or persons who may apply, additional or duplicate stereotype or electrotype plates from which any Government publication is printed, at a price not to exceed the cost of composition, the metal, and making to the Government, and ten per centum added: *Provided*, That the full amount of the price shall be paid when the order is filed: *And provided further*, That no publication reprinted from such stereotype or electrotype plates and no other Government publication shall be copyrighted.

In very many cases where cooperative work is carried on between the Department and one or several of the State agricultural experiment stations it has not been found possible to supply the stations with as many copies as they have found it necessary to distribute. To do so would be to impose a very great burden upon the printing fund of this Department, and, moreover, there is some possibility of the question being raised as to whether the Department can thus dispose of a great quantity of its publications paid for out of the general printing fund of the Department. Cooperative work of this character between the Department and the stations has been found so satisfactory to both that its increase is steady and promises to be very much greater in the future than in the past. In many cases already the station authorities have declared themselves ready and willing to print for their own use a special edition of the reports resulting from such cooperative work, and have, not unnaturally, asked that they might have the use of the plates already in existence as the result of publishing the Departmental report. In the section cited above the expense of supplying these plates has been greater than that of resetting the entire report, and has not infrequently resulted in the abandonment of a reprint by the station for its own use. It is earnestly desired that this section may be so amended as to permit the Public Printer, with the approval of the Secretary of Agriculture, to sell to the stations the plates of any report issued by the Department at a price sufficient to cover the cost of the metal and making of the plates, with 10 per cent added, but excluding the cost of composition.

## BLANKS, BLANK BOOKS, LETTER HEADS, ETC.

The frequency with which requests are received by this office to "make special" requisitions for the printing of blanks, blank books, letter heads, etc., induces me to again earnestly recommend that there should be someone in every Bureau, Division, and Office whose duty it is to look after such matters and order additional quantities before the supply is exhausted. If this rule were adopted, the use of the "special" red tag would be obviated and the inconvenience of having to wait for reprints, which now so often results, would be avoided. Time is required to execute printing requests, and requests that work be made special should, in order to be effective, be reserved for real emergencies which could not possibly have been foreseen. At least a six months' supply of blanks, blank books, letter heads, etc., should always be ordered.

## REORGANIZATION AS A BUREAU.

I submitted for your consideration in my last report a recommendation that the Division of Publications be reorganized as a Bureau. The present condition of the Division emphasizes the necessity for this recommendation. The growth and development of the Division have practically forced upon us an organization which is actually a Bureau organization and incompatible with that of a Division.

The Department Editor, who is also Chief of this Division, must necessarily be at all times one of the confidential aids of the Secretary. His first and most important duty, in fact, is to see that the publications of the Department are strictly in accord, at least in all non-technical matters, with the views and policy of the Secretary. In recommending the reorganization on a Bureau basis there is no purpose or design to weaken the closeness of this connection, but it is simply desired in order to strengthen the hands of the Editor in the performance of his responsible duties and to more efficiently meet the exigencies imposed by the great development and growth of the Division—a development and growth which have necessarily advanced step by step with the development and growth of the Department itself.

The Division force now numbers over 160 persons, and the appropriations controlled by its chief aggregate in round numbers \$550,000, a sum which will have to be considerably increased to meet the requirements of the next fiscal year. The work of the Division in its growth has naturally developed into four distinct branches, each one of which is considerably larger than was the Division itself when first organized.

We have now an editorial section under the immediate charge of Mr. B. D. Stallings, the work of which employs seven persons, besides taking up most of the time of the Editor in Chief and his first assistant. The fact that this branch of the work involved the editing of 414 new publications during the past year, to say nothing of many hundreds of reprints, many of which, being in the form of revised editions, called for a certain amount of editing, clearly evidences the amount and importance of the work devolving upon this section.

It was found necessary a year ago to organize the indexing work into a separate section, under Mr. C. H. Greathouse. The purpose of

this work and the other duties assigned to this section have been sufficiently explained elsewhere in this report. It is only necessary to add that the experience of the past year has demonstrated strongly the necessity for this section and the value of its work, not only to the Division of Publications itself, but to the whole Department.

The Document Section formed years ago a separate Division, and its present force, under Mr. R. B. Handy, the Assistant in Charge, numbers over 120 persons. The importance of the work devolving upon this section seems to be by many persons not fully appreciated. The extent of the work has already been clearly set forth in this report; but it is well to add here a fact frequently overlooked, but which adds greatly to the responsibility of the work, that through this section more than through any other branch of the Department work does the Department itself come into contact with the general public, which is naturally disposed to estimate the systematic and businesslike methods of work prevailing in the Department by its experience with the Document Section. Moreover, equally with the Seed Distribution, it is especially designed to serve Senators and Representatives.

The Section of Illustrations, like the Document Section, was at one time an independent Division, but now employs a force, including the assistant in charge, Mr. L. S. Williams, of 11 persons, and its work, especially in the photographic line, is rapidly increasing.

Every one of these four sections is practically itself a Division, and the responsibilities devolving upon the assistants in charge are those of Division chiefs; and it is but a matter of justice to these gentlemen that they should be so recognized, although the strongest argument for this reorganization lies in the fact that the efficiency of the work will be thereby enhanced and maintained. The simple fact is that our work has quite outgrown the Division organization. It is, in fact, now a Bureau embracing several independent divisions, and hence a reorganization on a broader scale and higher plane is urgently called for.

#### STATISTICS OF PUBLICATION WORK.

The details of the publication work of the Department for the year are given in the following tables:

*Number and classes of publications issued during the fiscal year 1906.*

Publications:	
Chargeable to regular printing fund.....	525
Chargeable to divisional funds.....	51
Chargeable to Farmers' Bulletin fund.....	437
Printed as Executive documents.....	58
Edited at Weather Bureau.....	100
Total.....	1,171



*Number of publications, original and reprint, and number of pages and copies of each class, fiscal years 1903-1906.*

Character of publication.	1903			1904		
	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.
Original.....	375	21,262	4,583,225	379	21,647	5,470,236
Reprint.....	482	21,912	6,295,000	514	15,018	6,076,300
Weather Bureau.....	81	1,831	820,339	79	1,241	839,850
Total.....	938	45,005	11,698,564	972	37,906	12,386,386

Character of publication.	1905			1906		
	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.
Original.....	391	18,988	5,538,672	414	20,942	6,423,400
Reprint.....	596	24,825	5,758,000	654	29,491	6,134,600
Weather Bureau.....	85	1,514	878,485	103	1,553	930,621
Total.....	1,072	45,327	12,475,157	1,171	51,986	13,488,621

*Number of publications issued (including reprints) during ten years, 1897 to 1906, inclusive.*

Year.	Number of publications.	Total number of copies.	Year.	Number of publications.	Total number of copies.
1897.....	424	6,541,200	1903.....	938	11,698,564
1898.....	501	6,280,365	1904.....	972	12,421,386
1899.....	603	7,075,975	1905.....	1,072	12,342,907
1900.....	468	7,152,428	1906.....	1,171	13,488,621
1901.....	606	7,899,281	Total.....	7,512	95,486,707
1902.....	757	10,586,580			

*Number of publications (original and reprint) and numbers of copies and pages, by Bureaus, Divisions, and Offices, fiscal year 1906.*

Bureaus, Divisions, and Offices.	Publications.			Pages.			Number of copies.		
	Original.	Reprint.	Total.	Original.	Reprint.	Total.	Original.	Reprint.	Total.
Secretary's office.....	9	3	12	411	232	643	142,750	30,000	172,750
Executive documents.....	58	.....	58	5,970	.....	5,970	808,000	.....	808,000
Accounts and Disbursements.....	1	.....	1	13	.....	13	300	.....	300
Animal Industry.....	35	119	154	1,474	4,417	5,891	171,700	1,262,200	1,433,900
Biological Survey.....	14	12	26	542	300	842	70,750	61,500	132,250
Chemistry.....	26	46	72	1,602	3,829	5,431	49,700	99,800	149,500
Entomology.....	35	59	94	704	3,364	4,068	89,700	304,450	394,150
Experiment Stations.....	94	164	258	5,543	7,670	13,213	497,100	1,807,650	2,304,750
Forest Service.....	23	54	77	786	2,761	3,547	436,000	310,500	746,500
Library.....	5	.....	5	756	.....	756	4,500	.....	4,500
Plant Industry.....	46	147	193	1,492	5,086	6,578	453,900	1,753,700	2,207,600
Publications.....	29	20	49	414	670	1,084	2,133,500	245,500	2,379,000
Public Roads.....	16	13	29	131	403	534	121,000	202,000	323,000
Soils.....	10	11	21	333	508	841	30,200	50,100	80,300
Statistics.....	23	6	29	771	171	942	1,414,300	6,600	1,420,900
Weather Bureau.....	99	4	103	1,502	131	1,633	899,121	31,500	930,621
Total.....	513	658	1,171	22,444	29,542	51,986	7,322,521	6,165,500	13,488,021

*Amount expended for the various Bureaus, Divisions, and Offices for printing and binding, 1906.*

Divisions of Accounts and Disbursements.....	\$2,404.12
Bureau of Animal Industry.....	3,678.51
Bureau of Biological Survey.....	3,678.19
Bureau of Chemistry.....	10,265.29
Bureau of Entomology.....	4,310.32
Office of Experiment Stations.....	26,577.65
Forest Service.....	10,446.73
Library.....	11,859.95
Bureau of Plant Industry.....	11,634.02
Division of Publications.....	4,603.74
Office of Public Roads.....	370.69
Bureau of Soils.....	2,973.13
Bureau of Statistics.....	16,329.75
Miscellaneous.....	5,338.63
Printing at branch printing office for the various Bureaus, Divisions, and Offices.....	33,933.12
<b>Total.....</b>	<b>158,043.84</b>

*Farmers' Bulletins issued, 1899-1906.*

Originals and reprints of Farmers' Bulletins.	Number of bulletins.	Number of copies.	Originals and reprints of Farmers' Bulletins.	Number of bulletins.	Number of copies.
Fiscal year 1906:			Fiscal year 1902:		
Originals.....	33	875,000	Originals.....	23	575,000
Reprints.....	404	5,693,000	Reprints.....	236	5,575,000
Total.....	437	6,568,000	Total.....	259	6,150,000
Fiscal year 1905:			Fiscal year 1901:		
Originals.....	24	630,000	Originals.....	14	415,000
Reprints.....	363	5,295,500	Reprints.....	157	2,930,000
Total.....	387	5,925,500	Total.....	171	3,345,000
Fiscal year 1904:			Fiscal year 1900:		
Originals.....	25	775,000	Originals.....	18	525,000
Reprints.....	390	5,660,000	Reprints.....	90	1,835,000
Total.....	415	6,435,000	Total.....	108	2,360,000
Fiscal year 1903:			Fiscal year 1899:		
Originals.....	22	725,000	Originals.....	22	520,000
Reprints.....	301	5,877,000	Reprints.....	154	1,917,000
Total.....	323	6,602,000	Total.....	176	2,437,000

*Cost of printing Farmers' Bulletins, 1900-1906.*

	Number of bulletins.	Number of copies.	Cost.
Fiscal year 1906:			
Paid from Farmers' Bulletin fund.....	437	6,568,000	\$98,601.49
Fiscal year 1905:			
Paid from Farmers' Bulletin fund.....	388	5,925,500	103,802.53
Fiscal year 1904:			
Paid from Farmers' Bulletin fund.....	415	6,435,000	104,787.68
Fiscal year 1903:			
Paid from Farmers' Bulletin fund.....	323	6,602,000	95,534.18
Fiscal year 1902:			
Paid from Farmers' Bulletin fund.....	259	6,150,000	107,363.05
Fiscal year 1901:			
Paid from Farmers' Bulletin fund.....	171	3,345,000	51,796.68
Fiscal year 1900:			
Paid from Farmers' Bulletin fund.....	97	2,150,000	30,665.15
Paid from general printing fund.....	11	210,000	3,469.69
Total.....	108	2,360,000	34,134.84

*New Farmers' Bulletins issued during the fiscal year 1906.*

No. of bulletin.	Title of bulletin.	Total number of copies.
227	Experiment Station Work—XXX	30,000
228	Forest Planting and Farm Management	30,000
229	The Production of Good Seed Corn	30,000
230	Game Laws for 1905. A Summary of the Provisions Relating to Seasons, Ship- ment, Sale, and Licenses	30,000
231	Spraying for Cucumber and Melon Diseases	30,000
232	Okra: Its Culture and Uses	20,000
233	Experiment Station Work—XXXI	30,000
234	The Guinea Fowl and Its Use as Food	20,000
235	Cement Mortar and Concrete: Preparation and Use for Farm Purposes	30,000
236	Incubation and Incubators	30,000
237	Experiment Station Work—XXXII	30,000
238	Citrus Fruit Growing in the Gulf States	30,000
239	The Corrosion of Fence Wire	20,000
240	Inoculation of Legumes	20,000
241	Butter Making on the Farm	30,000
242	An Example of Modern Farming	15,000
243	Fungicides and Their Use in Preventing Diseases of Fruits	30,000
244	Experiment Station Work—XXXIII	30,000
245	Renovation of Worn-out Soils	20,000
246	Saccharine Sorghum for Forage	30,000
247	The Control of the Codling Moth and Apple Seab	30,000
248	The Lawn	20,000
249	Cereal Breakfast Foods	30,000
250	The Prevention of Stinking Smut of Wheat and Loose Smut of Oats	25,000
251	Experiment Station Work—XXXIV	30,000
252	Maple Sugar and Sirup	30,000
253	The Germination of Seed Corn	40,000
254	The Cucumber	5,000
255	The Home Vegetable Garden	40,000
256	Preparation of Vegetables for the Table	20,000
257	Soil Fertility. An Address Delivered Before the Rich Neck Farmers' Club of Queen Anne County, Maryland	10,000
258	Texas or Tick Fever and Its Prevention	30,000
259	Experiment Station Work—XXXV	30,000

*Farmers' Bulletins, contributed by Bureaus, Divisions, and Offices, 1906.*

Bureaus, divisions, and offices.	New.	Re-prints.	Number of copies.
Secretary's Office		1	10,000
Bureau of Animal Industry	3	75	1,280,000
Bureau of Biological Survey	1	4	80,000
Bureau of Chemistry		6	65,000
Bureau of Entomology	1	25	295,000
Office of Experiment Stations	9	133	2,025,000
Forest Service	2	7	180,000
Bureau of Plant Industry	14	119	2,076,000
Division of Publications		17	232,000
Office of Public Roads	2	10	245,000
Bureau of Soils	1	4	50,000
Weather Bureau		3	30,000
Total	33	404	6,568,000

*Number of copies Farmers' Bulletins issued (Nos. 1 to 259) and number distributed to Members of Congress, 1894-1906.*

Date.	Total number of copies issued.	Congressional distribution.	Date.	Total number of copies issued.	Congressional distribution.
Prior to 1894	540,000		In 1901	3,345,000	2,195,010
In 1894	278,500		In 1902	6,150,000	4,289,126
In 1895	1,567,000	885,770	In 1903	6,602,000	3,954,976
In 1896	1,891,000	1,316,695	In 1904	6,435,000	4,895,556
In 1897	2,387,000	1,967,237	In 1905	5,925,500	4,782,643
In 1898	2,170,000	1,580,065	In 1906	6,568,000	5,279,476
In 1899	2,437,000	1,101,985			
In 1900	2,360,000	1,666,909	Total	48,656,000	33,915,448



*New Farmers' Bulletins issued each year from 1895 to 1906, inclusive.*

Year.	Number of bulletins.	Year.	Number of bulletins.
In 1895.....	11	In 1902.....	23
In 1896.....	13	In 1903.....	22
In 1897.....	16	In 1904.....	25
In 1898.....	21	In 1905.....	24
In 1899.....	22	In 1906.....	33
In 1900.....	18		
In 1901.....	14	Total.....	242

*Appropriations for the fiscal years 1903-1907.*

Appropriation.	1903	1904	1905	1906	1907
Statutory roll.....	\$28,820	\$29,320	\$30,640	\$114,370	\$116,270
General printing fund.....	<sup>a</sup> 155,000	<sup>b</sup> 160,000	<sup>b</sup> 160,000	<sup>b</sup> 160,000	<sup>b</sup> 275,000
Preparation, printing, and distribution of Farmers' Bulletins.....	107,500	105,000	105,000	98,750	98,750
Additional assistants, artists, draftsmen, etc.....	12,500	10,000	15,000	3,500	3,500
Labor, material, wagons, horses, rent of building, etc.....	<sup>c</sup> 84,000	85,000	90,000	30,000	30,000
Total.....	387,820	389,320	400,640	406,620	523,520

<sup>a</sup> Exclusive of \$20,000 for Weather Bureau.

<sup>b</sup> Exclusive of \$25,000 for Weather Bureau.

<sup>c</sup> Including a deficiency of \$4,000.

*Expenditures under general appropriations for fiscal year ended June 30, 1906.*

General printing fund.....	\$158,043.84
Preparation and printing of Farmers' bulletins.....	98,601.49
Additional assistants, artists, draftsmen, etc.....	3,434.10
Labor, material, etc.....	29,715.37
Total.....	289,794.80

*Expenditures for printing and binding, total and by funds, 1906.*

TOTAL EXPENDITURES.

Divisional publications paid from general fund.....	\$93,208.49
Divisional publications paid from special funds.....	15,386.96
Blank books, blank forms, etc., paid from general fund.....	30,902.23
Blank forms, etc., paid from special funds.....	3,587.92
Branch office (all work) paid from general fund.....	33,933.12
Farmers' Bulletins paid from Farmers' Bulletin fund.....	98,601.49
Total.....	275,620.21

EXPENDITURES BY FUNDS.

General printing fund (\$160,000, exclusive of \$25,000 for Weather Bureau):	
Expended for the various Bureaus, Divisions, and Offices.....	\$124,110.72
Expended for printing at branch office for the various Bureaus, Divisions, and Offices.....	33,933.12
	158,043.84
Farmers' Bulletin fund.....	98,601.49
Divisional funds:	
Office of Experiment Stations.....	4,389.96
Forest Service.....	13,298.68
Library.....	484.80
Bureau of Statistics.....	801.44
Total.....	275,620.21

*Requisitions on the branch printing office by Bureaus, Divisions, Offices, etc., 1905.*

Secretary's Office.....	251
Division of Accounts and Disbursements.....	181
Bureau of Animal Industry.....	404
Bureau of Biological Survey.....	94
Bureau of Chemistry.....	239
Bureau of Entomology.....	206
Office of Experiment Stations.....	282
Forest Service.....	615
Library.....	74
Bureau of Plant Industry.....	1,225
Division of Publications.....	232
Office of Public Roads.....	130
Bureau of Soils.....	88
Bureau of Statistics.....	443
Miscellaneous.....	38
Total.....	4,502

*Publications printed in the branch printing office, 1906.*

Bureaus, Divisions, and Offices.	Requisitions.	Number of copies printed.
Secretary's Office.....	3	60,000
Bureau of Animal Industry.....	14	21,500
Bureau of Biological Survey.....	7	9,250
Bureau of Chemistry.....	6	8,300
Bureau of Entomology.....	30	63,300
Office of Experiment Stations.....	2	3,200
Forest Service.....	4	13,500
Bureau of Plant Industry.....	7	32,500
Division of Publications.....	27	2,115,500
Office of Public Roads.....	12	56,000
Bureau of Soils.....	3	4,500
Total.....	115	2,387,550

*Requisitions on the main printing office by Bureaus, Divisions, and Offices.*

Secretary's Office.....	15
Division of Accounts and Disbursements.....	56
Bureau of Animal Industry.....	241
Bureau of Biological Survey.....	33
Bureau of Chemistry.....	105
Bureau of Entomology.....	134
Office of Experiment Stations.....	250
Forest Service.....	200
Library.....	49
Bureau of Plant Industry.....	353
Division of Publications.....	41
Office of Public Roads.....	40
Bureau of Soils.....	39
Bureau of Statistics.....	55
Miscellaneous.....	19
Total.....	1,630

## APPENDIX A.

### PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1906.

[The following publications were issued during the year ended June 30, 1906. Those to which a price is attached, with the exception of publications of the Weather Bureau, must be obtained of the Superintendent of Documents, Government Printing Office, Washington, D. C., to whom are turned over all copies not needed for official use, in compliance with section 67 of the act providing for the public printing and binding and the distribution of public documents. Remittances should be made to him by postal money order. Weather Bureau publications to which a price is attached must be obtained from the Chief of that Bureau. Applications for those that are for free distribution should be made to the Secretary of Agriculture, Washington, D. C.]

#### OFFICE OF THE SECRETARY.

	Copies.
Adulteration of Alfalfa and Red Clover Seed. Pp. 2. Circular No. 14, Office of the Secretary. Reprint, November 4, 1905-----	40,000
Report of the Secretary of Agriculture, 1905. Pp. 132. Preliminary. November 23, 1905-----	5,000
Report of the Secretary of Agriculture, 1905. Pp. 100. Report No. 81. December 6, 1905-----	70,000
Reprint, January 10, 1906-----	10,000
Reprint, January 20, 1906-----	10,000
Report on New Department Buildings for 1905. By B. T. Galloway, Chairman Building Committee. Pp. iii, 525-528. (From Annual Reports, Department of Agriculture.) February 2, 1906-----	250
Adulteration of Kentucky Bluegrass and Orchard Grass Seed. Pp. 5. Circular No. 15. February 14, 1906-----	40,000
Tests of Commercial Cultures of Nitrogen-Fixing Bacteria. Pp. 1. March 12, 1906-----	8,000
Report of the Appointment Clerk for 1905. By J. B. Bennett. Pp. ii, 529-549. (From Annual Reports, Department of Agriculture.) March 7, 1906-----	500
Standards of Purity for Food Products. (Supplementing Circular No. 13.) Pp. 7. Circular No. 17. April 13, 1906-----	12,000
Adulteration of Red Clover Seed. Pp. 1. Circular No. 18, May 25, 1906-----	5,000
Progress of the Beet-Sugar Industry in the United States in 1905. By Chas. F. Saylor, Special Agent. Pp. 130. figs. 5. Report No. 82. June 22, 1906-----	2,000
Marketing Farm Produce. By George G. Hill, formerly manager and editor of The American Farmer, Illinois. Pp. 32, figs. 7. Farmers' Bulletin No. 62. Reprint, August 28, 1905-----	10,000
Reprint, January 16, 1906-----	10,000
Reprint, April 24, 1906-----	15,000

#### CONGRESSIONAL.

Advance Sheets, <sup>a</sup> Field Operations of the Bureau of Soils, 1904: Soil Survey of the Charleston Area, South Carolina. By F. E. Bonsteel and E. P. Carr. Pp. 28, fig. 1, map. July 1, 1905-----	4,000
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<sup>a</sup> These Advance Sheets were issued in editions ranging from 4,000 to 10,000, of which the Department in each case received for distribution 1,000 copies, the remainder being apportioned to Senators and Representatives in Congress.



Advance Sheets, Field Operations, etc., 1904—Continued.		Copies.
Soil Survey of the Bainbridge Area, Georgia. By Elmer O. Fippin and J. A. Drake. Pp. 25, fig. 1, map. July 6, 1905-----		4, 000
Soil Survey of the San Antonio Area, Texas. By Thomas A. Caine and W. S. Lyman. Pp. 31, fig. 1, map. July 8, 1905-----		4, 000
Soil Survey of Coshocton County, Ohio. By Thomas D. Rice and W. J. Geib. Pp. 20, fig. 1, map. July 25, 1905-----		4, 000
Soil Survey of the Biloxi Area, Mississippi. By W. Edward Hearn and M. E. Carr. Pp. 26, fig. 1, map. August 16, 1905-----		4, 000
Soil Survey of the Bakersfield Area, California. By Macy H. Lapham and Charles A. Jensen. Pp. 32, fig. 1, maps 3. September 8, 1905--		4, 000
Soil Survey of the Kearney Area, Nebraska. By J. O. Martin and A. T. Sweet. Pp. 20, fig. 1, maps 2. September 26, 1905-----		4, 000
Soil Survey of the Booneville Area, Indiana. By A. W. Mangum and N. P. Neill. Pp. 27, fig. 1, map. September 28, 1905-----		4, 000
Soil Survey of the O'Fallon Area, Missouri-Illinois. By Elmer O. Fippin and J. A. Drake. Pp. 31, fig. 1, map. October 9, 1905----		13, 000
Soil Survey of the Wooster Area, Ohio. By Thomas A. Caine and W. S. Lyman. Pp. 26, fig. 1, map. October 10, 1905-----		8, 000
Soil Survey of Macon County, Alabama. By Henry J. Wilder and Hugh H. Bennett. Pp. 29, fig. 1, map. October 11, 1905-----		4, 000
Soil Survey of the Jackson Area, Mississippi. By J. O. Martin and O. L. Ayrs. Pp. 14, fig. 1, map. October 12, 1905-----		4, 000
Soil Survey of the Owosso Area, Michigan. By A. W. Mangum and Charles J. Mann. Pp. 27, fig. 1, map. October 16, 1905-----		4, 000
Soil Survey of Dodge County, Georgia. By Charles W. Ely and A. M. Griffen. Pp. 20, fig. 1, map. October 19, 1905-----		4, 000
Soil Survey of the Gainesville Area, Florida. By Thomas D. Rice and W. J. Geib. Pp. 25, fig. 1, map. October 23, 1905-----		6, 000
Soil Survey of the Saginaw Area, Michigan. By W. E. Lendon and M. Earl Carr. Pp. 46, fig. 1, map. October 24, 1905-----		8, 000
Soil Survey of the Austin Area, Texas. By A. W. Mangum and H. L. Belden. Pp. 30, fig. 1, map. October 25, 1905-----		4, 000
Soil Survey of Rhode Island. By F. E. Bonsteel and A. P. Carr. Pp. 30, maps 2. October 25, 1905-----		6, 000
Soil Survey of Scott County, Indiana. By A. W. Mangum and N. P. Neill. Pp. 24, fig. 1, map. October 26, 1905-----		4, 000
Soil Survey of the Vergennes Area, Vermont-New York. By Henry J. Wilder and H. L. Belden. Pp. 26, fig. 1, map. October 27, 1905----		4, 000
Soil Survey of the Cando Area, North Dakota. By Elmer O. Fippin and James L. Burgess. Pp. 29, fig. 1, map. October 28, 1905-----		4, 000
Soil Survey of Tama County, Iowa. By Charles W. Ely, George N. Coffey, and A. M. Griffen. Pp. 26, fig. 1, map. October 30, 1905----		4, 000
Soil Survey of Adams County, Pennsylvania. By Henry J. Wilder and H. L. Belden. Pp. 36, fig. 1, map. November 1, 1905-----		4, 000
Soil Survey of the Superior Area, Wisconsin-Minnesota. By Thomas A. Caine and W. S. Lyman. Pp. 22, fig. 1, map. November 1, 1905--		7, 000
Soil Survey of Marshall County, Indiana. By Frank Bennett and Charles W. Ely. Pp. 22, fig. 1, map. November 6, 1905-----		4, 000
Soil Survey of the Alma Area, Michigan. By W. Edward Hearn and A. M. Griffen. Pp. 30, fig. 1, map. November 8, 1905-----		4, 000
Soil Survey of Webster County, Missouri. By J. A. Drake and A. T. Strahorn. Pp. 18, fig. 1, map. November 3, 1905-----		4, 000
Soil Survey of the Greeneville Area, Tennessee-North Carolina. By Charles N. Mooney and O. L. Ayrs. Pp. 37, fig. 1, map. December 1, 1905-----		7, 000
Soil Survey of Lawrence County, Tennessee. By Charles N. Mooney and O. L. Ayrs. Pp. 22, fig. 1, map. December 16, 1905-----		4, 000
Soil Survey of Allen County, Kansas. By J. A. Drake and W. E. Tharp. Pp. 24, fig. 1, map. December 26, 1905-----		4, 000
Soil Survey of Sumter County, Alabama. By William G. Smith and F. N. Meeker. Pp. 30, fig. 1, map. January 5, 1906-----		4, 000
Soil Survey of Warren County, Kentucky. By Thomas D. Rice and W. J. Geib. Pp. 19, fig. 1, map. January 2, 1906-----		4, 000

	Copies.
Advance sheets—Field Operations, etc., 1904—Continued.	
Soil Survey of the San Bernardino Valley, California. By J. Garnett Holmes, Herbert W. Marean, N. P. Neill, Aldert S. Root, A. T. Sweet, and W. E. McLendon. Pp. 41, fig. 1, map. January 17, 1906.	6,000
Soil Survey of Anderson County, Texas. By William T. Carter, jr., and A. E. Kocher. Pp. 28, fig. 1, map. January 29, 1906.	4,000
Soil Survey of De Soto Parish, Louisiana. By Grove B. Jones and La Mott Ruhlen. Pp. 25, fig. 1, map. March 17, 1906.	4,000
Soil Survey of the Garden City Area, Kansas. By James L. Burgess and George N. Coffey. Pp. 33, fig. 1, map. April 3, 1906.	4,000
Soil Survey of the Auburn Area, New York. By J. E. Lapham and Hugh H. Bennett. Pp. 28, fig. 1, map. May 1, 1906.	4,000
Soil Survey of the Munising Area, Michigan. By Thomas D. Rice and W. J. Geib. Pp. 25, fig. 1, map. April 5, 1906.	4,000
Soil Survey of the Yuma Area, Arizona-California. By J. Garnett Holmes, Charles A. Jensen, Herbert W. Marean, N. P. Neill, Aldert S. Root, W. E. McLendon, J. L. Burgess, A. T. Strahorn, and A. T. Sweet. Pp. 27, fig. 1, maps 2. May 28, 1906.	6,000
Soil Survey of Lancaster County, South Carolina. By Aldert S. Root and L. A. Hurst. Pp. 20, fig. 1, map. June 1, 1906.	4,000
Advance sheets, Field Operations of the Bureau of Soils, 1905:	
Soil Survey of the Westerville Area, Ohio. By J. E. Lapham and Charles N. Mooney. Pp. 19, fig. 1, map. March 29, 1906.	10,000
Soil Survey of Lavaca County, Texas. By Charles N. Mooney, Frank Bennett, A. T. Strahorn, and H. L. Belden. Pp. 24, fig. 1, map. March 29, 1906.	4,000
Soil Survey of Lauderdale County, Alabama. By F. E. Bonsteel, Orla L. Ayrs, Thomas D. Rice, and E. P. Carr. Pp. 21, fig. 1, map. March 29, 1906.	4,000
Soil Survey of Spalding County, Georgia. By J. E. Lapham, W. S. Lyman and Charles W. Ely. Pp. 15, fig. 1, map. March 31, 1906.	4,000
Soil Survey of the Waco Area, Texas. By A. W. Mangum and M. Earl Carr. Pp. 37, fig. 1, map. April 3, 1906.	4,000
Soil Survey of Duplin County, North Carolina. By Aldert S. Root and Lewis A. Hurst. Pp. 23, fig. 1, map. March 21, 1906.	4,000
Soil Survey of Dallas County, Alabama. By E. P. Carr, W. Edward Hearn, Hugh H. Bennett, and R. T. Avon Burke. Pp. 24, fig. 1, map. March 5, 1906.	4,000
Soil Survey of East Baton Rouge Parish, Louisiana. By Charles W. Ely, Herbert W. Marean, and N. P. Neill. Pp. 23, fig. 1, map. April 5, 1906.	4,000
Soil Survey of Blount County, Alabama. By William G. Smith and F. N. Meeker. Pp. 22, fig. 1, map. April 14, 1906.	4,000
Soil Survey of the Crystalsprings Area, Mississippi. By James L. Burgess and W. E. Tharp. Pp. 23, fig. 1, map. April 26, 1906.	6,000
Soil Survey of Montgomery County, Alabama. By W. E. McLendon and Charles J. Mann. Pp. 32, fig. 1, map. June 5, 1906.	4,000
The Mexican Cotton Boll Weevil. A Revision and Amplification of Bulletin No. 45, to Include the Most Important Observations made in 1904. Prepared under the direction of the Entomologist, by W. D. Hunter and W. E. Hinds. Pp. 181, pls. 23, figs. 8. July 10, 1905.	30,000
Annual Report of the Office of Experiment Stations for the Year ended June 30, 1904. Pp. 724, pls. 42, figs. 11. August 8, 1905.	8,000
Report of the Chief of the Weather Bureau, 1903-1904. Parts I to VI. Pp. xxxix, 1-381. October 6, 1905.	4,000
Twenty-first Annual Report of the Bureau of Animal Industry for the Year 1904. Pp. 632, pls. 47, figs. 50. December 19, 1905.	30,000
Field Operations of the Bureau of Soils, 1904. By Milton Whitney, Chief. With Accompanying Papers by Assistants in Charge of Field Parties. Pp. 1159, pl. 1, figs. 45, maps in portfolio 53. January 26, 1906.	10,500
Annual Reports of the Department of Agriculture for the Fiscal Year ended June 30, 1905. Report of the Secretary of Agriculture. Departmental Reports. Pp. cxxxiv, 569. March 24, 1906.	3,000
Yearbook of Department of Agriculture for 1905. Pp. 815, pls. 73, figs. 130. June 22, 1905. Price \$1.	500,000

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American Grasses—III. Description of the Tribes and Genera. By F. Lamson-Scribner, Agrostologist. Pp. 197, figs. 137. Bulletin No. 20, revised. Reprint, March 27, 1906. Price, 15 cents.....	500
Economic Grasses. By F. Lamson-Scribner, Agrostologist. Pp. 85, pls. 3, figs. 91. Bulletin No. 14, revised. Reprint, May 5, 1906. Price, 10 cents.....	1,000
Southern Forage Plants. Compiled from the Publications of the Division of Agrostology. By F. Lamson-Scribner, Agrostologist. Pp. 48, figs. 14. Farmers' Bulletin No. 102. Reprint, August 14, 1905.....	10,000
Reprint, January 23, 1906.....	10,000
Reprint, May 14, 1906.....	5,000
Meadows and Pastures: Formation and Cultivation in the Middle Eastern States. By Jared G. Smith, Assistant Agrostologist. Pp. 30, figs. 9. Farmers' Bulletin No. 66, edition of March, 1904. September 22, 1905.....	10,000
Reprint, March 23, 1906.....	10,000
Millet. By Thomas A. Williams, Assistant Agrostologist. Pp. 32, figs. 6. Farmers' Bulletin No. 101. Reprint, October 6, 1905.....	10,000
Reprint, May 21, 1906.....	10,000
Cattle Ranges of the Southwest: A History of the Exhaustion of the Pasturage and Suggestions for Its Restoration. By H. L. Bentley, Special Agent in Charge of Grass Station at Abilene, Texas. Pp. 32, figs. 9. Farmers' Bulletin No. 72. Reprint, May 23, 1906.....	5,000

*Botany.*

Shade in Coffee Culture. By O. F. Cook, Special Agent for Tropical Agriculture. Pp. 79, pls. 16. Bulletin No. 25. Reprint, January 2, 1902. Price, 15 cents.....	500
The Camphor Tree ( <i>Cinnamomum camphora</i> Nees & Eberm.). By Lyster H. Dewey, Assistant in Division of Botany. Pp. 8, figs. 2. Circular No. 12, revised. Reprint, April 7, 1906.....	1,000
Yams in the West Indies. By David G. Fairchild, Agricultural Explorer. Pp. 4, fig. 1. Circular No. 21, new edition. Reprint, May 7, 1906.....	500
Crimson Clover Seed. By Edgar Brown, in Charge of Seed Laboratory. Pp. 4, figs. 4. Circular No. 18, second revision. Reprint, June 4, 1906.....	1,000
Wild Garlic ( <i>Allium vineale</i> L.). By Lyster H. Dewey, Assistant in Division of Botany. Pp. 8, figs. 3. Circular No. 9, second revision. Reprint, June 11, 1906.....	1,000
Red Clover Seed: Information for Purchasers. By A. J. Pieters, Assistant Botanist, Division of Botany, in Charge of Pure Seed Investigations. Pp. 16, figs. 2. Farmers' Bulletin No. 123. Reprint, August 25, 1905.....	10,000
Thirty Poisonous Plants of the United States. By V. K. Chesnut, Assistant Botanist. Pp. 32, figs. 24. Farmers' Bulletin No. 86. Reprint, October 2, 1905.....	10,000
Reprint, March 24, 1906.....	10,000
The Farmers' Interest in Good Seed. By A. J. Pieters, in Charge of Pure Seed Investigations, Division of Botany. Pp. 24, figs. 7. Farmers' Bulletin No. 111. Reprint, April 18, 1906.....	15,000

*Pomology.*

Grape Growing in the South. By S. M. Tracy, M. S., formerly Director of the Mississippi Agricultural Experiment Stations. Pp. 32, figs. 6. Farmers' Bulletin No. 118. Reprint, December 7, 1905.....	10,000
Reprint, May 2, 1906.....	15,000

*Vegetable physiology and pathology.*

The Wilt Disease of Cotton and Its Control. By W. A. Orton, Associate Pathologist. Pp. 16, pls. 4. Bulletin No. 27. Reprint, April 17, 1906. Price, 5 cents.....	500
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	Copies.
Spraying for Fruit Diseases. By B. T. Galloway, Chief of Division of Vegetable Physiology and Pathology. Pp. 13, figs. 6. Farmers' Bulletin No. 38. Reprint, August 1, 1905-----	10, 000
Potato Diseases and Their Treatment. By B. T. Galloway, Chief of the Division of Vegetable Physiology and Pathology. Pp. 16. Farmers' Bulletin No. 91. Reprint, August 16, 1905-----	15, 000
Reprint, December 29, 1905-----	15, 000
Reprint, April 7, 1906-----	20, 000
Peach Growing for Market. By Erwin F. Smith, Division of Vegetable Physiology and Pathology. Pp. 24, figs. 21. Farmers' Bulletin No. 33. Reprint, August 23, 1905-----	10, 000
Reprint, January 25, 1906-----	10, 000
The Black Rot of the Cabbage. By Erwin F. Smith, Division of Vegetable Physiology and Pathology. Pp. 22, fig. 1. Farmers' Bulletin No. 68. Reprint, April 26, 1906-----	10, 000

## PUBLICATIONS.

Monthly List of Publications, June, 1905. Pp. 8-----	150, 000
Monthly List of Publications, July, 1905. Pp. 4-----	151, 000
Reprint-----	6, 000
Monthly List of Publications, August, 1905. Pp. 4-----	158, 000
Monthly List of Publications, September, 1905. Pp. 4-----	158, 000
Reprint-----	2, 500
Monthly List of Publications, October, 1905. Pp. 4-----	178, 000
Monthly List of Publications, November, 1905. Pp. 4-----	178, 000
Monthly List of Publications, December, 1905. Pp. 4-----	181, 000
Monthly List of Publications, January, 1906. Pp. 4-----	183, 000
Monthly List of Publications, February, 1906. Pp. 4-----	188, 000
Monthly List of Publications, March, 1906. Pp. 4-----	188, 000
Monthly List of Publications, April, 1906. Pp. 4-----	188, 000
Monthly List of Publications, May, 1906. Pp. 4-----	203, 500
A Directory for Farmers. Corrected to April 1, 1905. With Weather Conditions, Crop Injuries, etc., for 1904. Pp. v, 539-625. (From Yearbook of Department of Agriculture for 1904.) July 13, 1905-----	10, 000
List of Bulletins and Circulars Issued by the U. S. Department of Agriculture and Available for Free Distribution in the United States, Corrected to July 1, 1905. Pp. 38. No. 247. August 19, 1905-----	10, 000
Reprint, May 31, 1906-----	5, 000
Organization of Department of Agriculture, 1905-1906. By Geo. Wm. Hill, Editor. Pp. 31. Circular No. 1, revised. December 5, 1905-----	2, 500
Report of the Editor for 1905. By Geo. Wm. Hill. Pp. ii, 327-404. (From Annual Reports, Department of Agriculture.) January 25, 1906-----	1, 500
Publications of the United States Department of Agriculture for Sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Corrected to March 1, 1906. Pp. 74. No. 179, thirteenth edition. May 15, 1906-----	10, 000
The Vegetable Garden. By Charles H. Greathouse, A. M. Pp. 24, figs. 8. Farmers' Bulletin No. 94. Reprint, August 12, 1905-----	15, 000
Reprint, January 27, 1906-----	15, 000
Reprint, April 30, 1906-----	15, 000
Reprint, May 11, 1906-----	15, 000
Asparagus Culture. By R. B. Handy. Pp. 40, figs. 17. Farmers' Bulletin No. 61. Reprint, September 20, 1905-----	10, 000
Reprint, April 17, 1906-----	15, 000
Suggestions to Southern Farmers. Prepared in the Division of Publications. Pp. 48. Farmers' Bulletin No. 98. Reprint, October 5, 1905-----	15, 000
Reprint, April 9, 1906-----	15, 000
Clearing New Land. By Franklin Williams, Jr., Farmer and Horticulturist, Fairfax County, Va. Pp. 24, figs. 7. Farmers' Bulletin No. 150. Reprint, October 9, 1905-----	10, 000
Reprint, April 13, 1906-----	10, 000



	Copies.
Practical Suggestions for Farm Buildings. By George G. Hill. Pp. 48, figs. 28. Farmers' Bulletin No. 126. Reprint, October 25, 1905-----	10, 000
Reprint, December 5, 1905-----	15, 000
Reprint, March 6, 1906-----	15, 000
Reprint, April 19, 1906-----	20, 000
Reprint, May 31, 1906-----	12, 000
OFFICE OF PUBLIC ROADS.	
Building Sand-Clay Roads in Southern States. By W. L. Spoon, Special Agent. Pp. iii, 259-266, pls. 2, figs. 3. (From Yearbook of Department of Agriculture for 1903.) Reprint, September 28, 1905-----	1, 000
Use of Mineral Oil in Road Improvement. By James W. Abbott, Special Agent, Rocky Mountain and Pacific Coast Division. Pp. iii, 439-454, pls. 3, figs. 4. (From Yearbook of Department of Agriculture for 1902.) Reprint, October 19, 1905-----	1, 000
A Study of Rock Decomposition under the Action of Water. By Allerton S. Cushman. Pp. 10, figs. 3. Circular No. 38. October 28, 1905-----	5, 000
Practical Road Building in Madison County, Tennessee. By Sam C. Lancaster, Chief Engineer Madison County Good Roads Commission. Pp. ii, 323-340, pls. 5, figs. 5. (From Yearbook of Department of Agriculture for 1904.) Reprint, December 28, 1905-----	5, 000
Report of the Director of the Office of Public Roads for 1905. By Logan Waller Page, Director. Pp. iii, 423-438. (From Annual Reports, Department of Agriculture, 1905.) January 31, 1906-----	3, 000
Public Roads of the State of Washington: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 2. Circular No. 39. April 4, 1906-----	4, 000
Public Roads of Arizona: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Circular No. 40. Pp. 2. April 13, 1906-----	5, 000
Public Roads of Oregon: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 2. Circular No. 42. April 28, 1906-----	5, 000
Public Roads of Arkansas: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 3. Circular No. 41. April 26, 1906-----	5, 000
Public Roads of Virginia: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 4. Circular No. 44. April 28, 1906-----	5, 000
Public Roads of North Carolina: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 4. Circular No. 45. May 15, 1906-----	5, 000
Public Roads of Iowa: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 3. Circular No. 43. May 21, 1906-----	5, 000
Tar and Oil for Road Improvement: Report of Progress of Experiment at Jackson, Tennessee. Pp. 8. Circular No. 47. June 1, 1906-----	3, 000
Public Roads of New Hampshire: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 2. Circular No. 49. June 14, 1906-----	6, 000
Public Roads of Alabama: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 3. Circular No. 46. June 14, 1906-----	5, 000
Public Roads of Tennessee: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 4. Circular No. 48. June 13, 1906-----	5, 000
Public Roads of Maryland: Mileage and Expenditures in 1904. By Maurice O. Eldridge, Chief of Records. Pp. 2. Circular No. 50. June 21, 1906-----	10, 000
Earth Roads. By Maurice O. Eldridge, Assistant Director, Public Road Inquiries. Pp. 24, figs. 20. Farmers' Bulletin No. 136. Reprint, August 29, 1905-----	15, 000
Reprint, February 26, 1906-----	15, 000
Reprint, May 1, 1906-----	20, 000

	Copies.
Good Roads for Farmers. By Maurice O. Eldridge, Acting Director, Office of Public Road Inquiries. Pp. 48. Farmers' Bulletin No. 95. Reprint, September 7, 1905.....	15,000
Reprint, January 30, 1906.....	15,000
Reprint, March 13, 1906.....	20,000
Reprint, May 31, 1906.....	30,000
Cement Mortar and Concrete: Preparation and Use for Farm Purposes. By Philip L. Wormley, jr., Testing Engineer. Pp. 32, figs. 14. Farmers' Bulletin No. 235. December 13, 1905.....	30,000
Reprint, February 24, 1906.....	20,000
Reprint, April 19, 1906.....	30,000
The Corrosion of Fence Wire. By Allerton S. Cushman, Assistant Director. Pp. 31. Farmers' Bulletin No. 239. December 29, 1905.....	20,000
Reprint, April 5, 1906.....	15,000

## BUREAU OF SOILS.

Manurial Requirements of the Cecil Silt Loam of Lancaster County, S. C. By F. D. Gardner, in Charge of Soil Management, and F. E. Bonsteel, Assistant. Pp. 7. Circular No. 16. August 11, 1905.....	3,500
The Work of the Bureau of Soils. Pp. 15. Circular No. 13, revised. October 6, 1905.....	5,000
Tobacco Investigations in Ohio. By George T. McNess and George B. Massey. Pp. 38. Bulletin No. 29. September 18, 1905. Price, 5 cents.....	6,000
Manurial Requirements of the Portsmouth Sandy Loam of the Darlington Area, South Carolina. Pp. 10. Circular No. 17. October 4, 1905.....	3,500
Investigations in Soil Management. Part I.—Amount of Plant Food Readily Recoverable from Field Soils with Distilled Water. Part II.—Relation of Crop Yields to the Amounts of Water-Soluble Plant-Food Materials Recovered from Soils. Part III.—Relation of Differences of Climatological Environment to Crop Yields. By Prof. F. H. King, Chief of the Division of Soil Management. Pp. 205, pls. 3, figs. 9. Bulletin No. 26, reprint, October 19, 1905. Price 15 cents.....	1,000
Studies on the Properties of Unproductive Soil. By Burton Edward Livingston, J. C. Britton, and F. R. Reid. Pp. 39. Bulletin No. 28. October 25, 1905. Price 5 cents.....	3,000
Investigations in Soil Fertility. By Milton Whitney and F. K. Cameron. Pp. 48, pls. 4, figs. 7. Bulletin No. 23. Reprint, November 24, 1905.....	800
The Mineral Constituents of the Soil Solution. By Frank K. Cameron and James M. Bell. Pp. 70, figs. 4. Bulletin No. 30. December 18, 1905. Price, 5 cents.....	2,000
Reprint, January 20, 1906.....	800
Reprint, March 29, 1906.....	500
Report of the Chief of the Bureau of Soils for 1905. By Milton Whitney. Pp. iii, 239–272. (From Annual Reports, Department of Agriculture.) January 19, 1906.....	200
Colorimetric, Turbidity, and Titration Methods Used in Soil Investigations. By Oswald Schreiner and George H. Failyer. Pp. 60, pl. 1, figs. 5. Bulletin No. 31. February 6, 1906. Price, 5 cents.....	2,500
The Mechanics of Soil Moisture. By Lyman J. Briggs, Physicist, Division of Soils. Pp. 24, figs. 7. Bulletin No. 10. Reprint, March 29, 1906. Price, 5 cents.....	500
The Use of Alkaline and Saline Waters for Irrigation. By Thomas H. Means, in Charge of Alkali Reclamation Work. Pp. 4. Circular No. 10. Reprint, April 17, 1906.....	500
Reprint, April 18, 1906.....	500
The Absorption of Phosphates and Potassium by Soils. By Oswald Schreiner and George H. Failyer. Pp. 39, figs. 6. Bulletin No. 32. April 24, 1906. Price, 10 cents.....	2,500
Reclamation of Alkali Soils. By Clarence W. Dorsey. Pp. 30, pls. 4. Bulletin No. 34. June 19, 1906. Price, 10 cents.....	2,500
The Wire-Basket Method for Determining the Manurial Requirements of Soils. By Frank D. Gardner, in Charge of Soil Management. Pp. 6, figs. 2. Circular No. 18. May 21, 1906.....	2,500

	Copies.
Tobacco Soils. By Milton Whitney, Chief of Division of Soils. Pp. 24, fig. 1. Farmers' Bulletin No. 83. Reprint, August 19, 1905-----	10,000
Reprint, April 10, 1906-----	10,000
The Culture of Tobacco. By Otto Carl Butterweck. Pp. 22. Farmers' Bulletin No. 82. Reprint, August 21, 1906-----	10,000
Reprint, March 31, 1906-----	10,000
Soil Fertility. An Address Delivered Before the Rich Neck Farmers' Club, of Queen Anne County, Maryland. By Milton Whitney, Chief of the Bureau of Soils. Pp. 40, figs. 2. Farmers' Bulletin No. 257. June 19, 1906-----	10,000

## BUREAU OF STATISTICS.

Crop Reporter, Vol. 7, No. 3-----	105,000
Crop Reporter, Vol. 7, No. 4-----	107,000
Crop Reporter, Vol. 7, No. 5-----	105,000
Crop Reporter, Vol. 7, No. 6-----	105,000
Crop Reporter, Vol. 7, No. 7-----	105,000
Crop Reporter, Vol. 7, No. 8-----	105,000
Reprint-----	600
Crop Reporter, Vol. 7, No. 8, supplement-----	105,000
Reprint-----	2,000
Crop Reporter, Vol. 7, No. 9-----	105,000
Crop Reporter, Vol. 7, No. 10-----	105,000
Crop Reporter, Vol. 7, No. 11-----	105,000
Crop Reporter, Vol. 7, No. 12-----	105,000
Crop Reporter, Vol. 8, No. 1-----	105,000
Crop Reporter, Vol. 8, No. 2-----	105,000
Crop Reporter, Vol. 1, No. 8. Reprint, June 22, 1906-----	300
The Commercial Cotton Crop of 1903-4. By James L. Watkins. Pp. 101. Bulletin No. 34. September 26, 1905. Price, 5 cents-----	2,000
Trade with Noncontiguous Possessions in Farm and Forest Products, 1902-1904. Compiled by the Division of Foreign Markets. Pp. 49. Bulletin No. 37. October 19, 1905. Price, 10 cents-----	4,800
Crop Export Movement and Port Facilities on the Atlantic and Gulf Coasts. By Frank Andrews, Expert in Transportation Statistics. Division of Foreign Markets. Pp. 80. Bulletin No. 38. October 28, 1905. Price, 5 cents-----	5,400
Imports of Farm and Forest Products, 1902-1904, by Countries from Which Consigned. Compiled by the Division of Foreign Markets. Pp. 82. Bulletin No. 35. November 6, 1905-----	5,000
Exports of Farm and Forest Products, 1902-1904, by Countries to Which Consigned. Compiled by the Division of Foreign Markets. Pp. 108. Bulletin No. 36. November 3, 1905-----	5,000
Meat in Foreign Markets, Tariffs of Fourteen Importing Nations, and Countries of Surplus. Prepared by the Division of Foreign Markets. Pp. 95. Bulletin No. 39. January 22, 1906. Price, 5 cents-----	7,100
Reprint, April 2, 1906-----	2,500
Report of the Bureau of Statistics for 1905. By W. M. Hays, Assistant Secretary, in Charge. Pp. ii, 405-417. (From Annual Reports, Department of Agriculture.) January 31, 1905-----	2,500
Meat Animals and Packing-House Products Imported into Eleven Principal Countries, 1895-1904. Prepared by the Division of Foreign Markets. Pp. 92. Bulletin No. 40. March 2, 1906. Price, 5 cents-----	7,500
Norway, Sweden, and Russia as Markets for Packing-House Products. Imports for Principal Countries, 1895-1904. Prepared by the Division of Foreign Markets. Pp. 21. Bulletin No. 41. March 2, 1906. Price, 5 cents-----	7,500
Reprint, March 21, 1906-----	2,500
Progress of Agriculture in the United States. By George K. Holmes, Assistant Statistician. Pp. iii, 307-334. (From Yearbook of Department of Agriculture for 1899.) Reprint, May 4, 1906-----	500
Causes Affecting Farm Values. By George K. Holmes, Chief of Division of Foreign Markets. Pp. ii, 511-532. (From Yearbook of Department of Agriculture for 1905.) June 30, 1906-----	500



## WEATHER BUREAU.

Copies.

Monthly Weather Review (a summary by months of weather conditions throughout the United States, based upon reports of nearly 3,000 regular and voluntary observers). Quarto. Price, 20 cents; \$2 per year.	
Vol. XXXIII. No. 5. May, 1905. Pp. 183-232, charts 10, figs. 10	5, 100
Vol. XXXIII. No. 6. June, 1905. Pp. 233-285, charts 9, figs. 11	5, 100
Vol. XXXIII. No. 7. July, 1905. Pp. 287-348, charts 8, pl. 1, figs. 9	5, 200
Vol. XXXIII. No. 8. August, 1905. Pp. 349-384, charts 9	5, 200
Vol. XXXIII. No. 9. September, 1905. Pp. 385-431, charts 9	5, 200
Vol. XXXIII. No. 10. October, 1905. Pp. 433-469, charts 10	5, 200
Vol. XXXIII. No. 11. November, 1905. Pp. 471-513, charts 11	5, 200
Vol. XXXIII. No. 12. December, 1905. Pp. 515-570, charts 11	5, 250
Vol. XXXIII. No. 13. Annual Summary. Pp. xv, 571-591, charts 14	5, 250
Vol. XXXIV. No. 1. January, 1906. Pp. 60, charts 8	5, 250
Vol. XXXIV. No. 2. February, 1906. Pp. 61-108, charts 34, figs. 8	5, 250
Vol. XXXIV. No. 3. March, 1906. Pp. 109-156, charts 7, figs. 9	5, 250
Vol. XXXIV. No. 4. April, 1906. Pp. 157-200, charts 7, pls. 2	5, 250
Temperature and Relative Humidity Data. By William B. Stockman, Chief, Division of Meteorological Records. Pp. 29, charts 2. Bulletin O (W. B. No. 334). September 18, 1905	1, 500
Meteorological Chart of the Great Lakes. No. 1, 1905. By Alfred J. Henry and Norman B. Conger. Pp. 19, chart. (W. B. No. 333.) September 18, 1905	2, 500
Improved Methods for Finding Altitude and Azimuth, Geographical Position, and the Variation of the Compass. Pp. 8, figs. 7. (W. B. No. 336.) September 18, 1905	3, 000
Daily River Stages at River Gage Stations on the Principal Rivers of the United States. Part VII. For the Years 1900, 1901, 1902, 1903, and 1904. By H. C. Frankenfield, Professor of Meteorology. Pp. 328. (W. B. No. 339.) February 5, 1906. Price, paper, \$11; cloth, \$13	350
A First Report on the Relations Between Climates and Crops. By Cleveland Abbe. Pp. 386. Bulletin No. 36. (W. B. No. 342.) February 23, 1906. Price, \$1.50	1, 000
Meteorological Chart of the Great Lakes. Summary for the Season of 1905. No. 2, 1905. By Alfred J. Henry and Norman B. Conger. Pp. 12, chart 1. (W. B. No. 350.) March 13, 1906. Price, 10 cents	2, 500
Recent Practice in the Erection of Lightning Conductors. By Alfred J. Henry, Professor of Meteorology. Pp. 20. Bulletin No. 37. (W. B. No. 349.) March 15, 1905. Price, 10 cents	1, 000
Studies on the Diurnal Periods in the Lower Strata of the Atmosphere. By Frank Hagar Bigelow, M. A., L. H. D., Professor of Meteorology. (Reprints from the Monthly Weather Review, February, March, April, May, July, August, 1905.) Pp. 51, figs. 71. Reprint, April 2, 1906	1, 500
Meteorological Chart of the Great Lakes, No. 1, 1906. By Alfred J. Henry and Norman B. Conger. Pp. 20. (W. B. No. 356.) June 26, 1906. Price, 10 cents	2, 500
Annual Report of the Chief of the Weather Bureau, 1905	5, 000
Weather Crop Bulletin No. 16. July 3, 1905	4, 575
Weather Crop Bulletin No. 17. July 10, 1905	4, 575
Weather Crop Bulletin No. 18. July 17, 1905	4, 575
Weather Crop Bulletin No. 19. July 24, 1905	3, 000
Weather Crop Bulletin No. 20. July 31, 1905	4, 575
Weather Crop Bulletin No. 21. August 7, 1905	4, 575
Weather Crop Bulletin No. 22. August 14, 1905	4, 575
Weather Crop Bulletin No. 23. August 21, 1905	4, 575
Weather Crop Bulletin No. 24. August 28, 1905	4, 600
Weather Crop Bulletin No. 25. September 4, 1905	4, 600
Weather Crop Bulletin No. 26. September 11, 1905	4, 600

	Copies.
Weather Crop Bulletin No. 27. September 18, 1905-----	4, 600
Weather Crop Bulletin No. 28. September 25, 1905-----	4, 600
Weather Crop Bulletin No. 29. October 2, 1905-----	4, 600
Weather Crop Bulletin No. 30. November, 1905-----	4, 950
Weather Crop Bulletin No. 31. November, 1905-----	5, 100
Weather Crop Bulletin No. 32. December, 1905-----	5, 100
Weather Crop Bulletin No. 1. January, 1906-----	5, 100
Weather Crop Bulletin No. 2. February, 1906-----	5, 100
Weather Crop Bulletin No. 3. March, 1906-----	5, 100
Weather Crop Bulletin No. 4. April 9, 1906-----	4, 050
Weather Crop Bulletin No. 5. April 16, 1906-----	4, 650
Weather Crop Bulletin No. 6. April 26, 1906-----	4, 650
National Weekly Weather Bulletin No. 7. April 30, 1906-----	4, 650
National Weekly Weather Bulletin No. 8. May 7, 1906-----	4, 650
National Weekly Weather Bulletin No. 9. May 14, 1906-----	4, 550
National Weekly Weather Bulletin No. 10. May 21, 1906-----	4, 550
National Weekly Weather Bulletin No. 11. May 28, 1906-----	4, 550
National Weekly Weather Bulletin No. 12. June 4, 1906-----	4, 550
National Weekly Weather Bulletin No. 13. June 11, 1906-----	4, 550
National Weekly Weather Bulletin No. 14. June 18, 1906-----	4, 550
National Weekly Weather Bulletin No. 15. June 25, 1906-----	2, 500
Snow and Ice Bulletin. December 5, 1905-----	1, 800
Snow and Ice Bulletin. December 12, 1905-----	1, 800
Snow and Ice Bulletin. December 19, 1905-----	1, 800
Snow and Ice Bulletin. December 26, 1905-----	1, 800
Snow and Ice Bulletin. January 2, 1906-----	1, 800
Snow and Ice Bulletin. January 9, 1906-----	1, 850
Snow and Ice Bulletin. January 16, 1906-----	1, 850
Snow and Ice Bulletin. January 23, 1906-----	1, 850
Snow and Ice Bulletin. January 30, 1906-----	1, 850
Snow and Ice Bulletin. February 6, 1906-----	1, 850
Snow and Ice Bulletin. February 13, 1906-----	1, 850
Snow and Ice Bulletin. February 20, 1906-----	1, 850
Snow and Ice Bulletin. February 27, 1906-----	1, 840
Snow and Ice Bulletin. March 6, 1906-----	1, 800
Snow and Ice Bulletin. March 13, 1906-----	1, 800
Snow and Ice Bulletin. March 20, 1906-----	1, 800
Snow and Ice Bulletin. March 27, 1906-----	1, 800
Cotton Region Weather Crop Bulletin No. 1. P. 1. October 12, 1905---	4, 900
Cotton Region Weather Crop Bulletin No. 2. P. 1. October 19, 1905---	4, 900
Cotton Region Weather Crop Bulletin No. 3. P. 1. October 25, 1905---	4, 900
Cotton Region Weather Crop Bulletin No. 4. P. 1. October 31, 1905---	4, 900
Daily Weather map (showing weather conditions throughout the United States and giving forecasts of probable changes).	
July, 1905-----	49, 107
August, 1905-----	49, 375
September, 1905-----	46, 638
October, 1905-----	50, 760
November, 1905-----	50, 742
December, 1905-----	50, 878
January, 1906-----	51, 387
February, 1906-----	51, 394
March, 1906-----	51, 409
April, 1906-----	52, 940
May, 1906-----	52, 989
June, 1906-----	52, 881
Protection of Food Products from Injurious Temperatures. By H. E. Williams, Chief Clerk, Weather Bureau. Pp. 28. Farmers' Bulletin No. 125. Reprint, September 18, 1905-----	10, 000
Reprint, April 4, 1906-----	10, 000
Notes on Frost. By E. B. Garriott, Professor of Meteorology. Pp. 24. Farmers' Bulletin No. 104. Reprint, November 20, 1905-----	10, 000

## APPENDIX B.

### REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING THE FISCAL YEAR ENDED JUNE 30, 1905, THE PUBLICATION OF WHICH IS PROVIDED FOR BY LAW.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that Bureau specially charged with such work, and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this Division. A list of Weather Bureau publications is given in separate tables.]

*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to  
June 30, 1906.*

Publications.	Received.	Distrib- uted. <sup>a</sup>
Publications on hand July 1, 1905..... <sup>b</sup> 852,688		353,108
OFFICE OF APPOINTMENT CLERK.		
Report of the Appointment Clerk, 1905.....	500	500
DIVISION OF ACCOUNTS AND DISBURSEMENTS.		
Report of the Chief of Division of Accounts and Disbursements, 1905.....	300	75
BUREAU OF ANIMAL INDUSTRY.		
Report of the Chief, 1905.....	1,000	240
Twenty-first Annual Report Bureau of Animal Industry.....	9,000	7,360
Bulletin No. 29 (reprint).....	2,000	1,360
Bulletin No. 31 (reprint).....	2,000	1,311
Bulletin No. 34 (reprint).....	3,000	129
Bulletin No. 37 (reprint).....	1,500	699
Bulletin No. 39, part 9.....	2,000	1,600
Bulletin No. 39, part 10.....	2,000	1,561
Bulletin No. 39, part 11.....	2,000	1,672
Bulletin No. 39, part 12.....	2,000	1,311
Bulletin No. 39, part 13.....	2,000	1,314
Bulletin No. 45 (reprint).....	1,000	33
Bulletin No. 46 (reprint).....	1,000	82
Bulletin No. 47 (reprint).....	1,000	1,034
Bulletin No. 50 (reprint).....	500	50
Bulletin No. 52, part 1.....	2,000	231
Bulletin No. 52, part 2.....	2,000	284
Bulletin No. 56, part 2.....	500	500
Bulletin No. 61, part 2.....	500	133
Bulletin No. 64, part 2.....	1,000	533
Bulletin No. 66, part 2.....	500	1,200
Bulletin No. 67, part 2.....	1,500	2,300
Bulletin No. 70 (reprint).....	1,500	2,467
Bulletin No. 71.....	3,000	1,201
Bulletin No. 73.....	3,200	2,200
Bulletin No. 74.....	2,500	2,175
Bulletin No. 75.....	3,600	3,600
Bulletin No. 76.....	3,000	2,514
Bulletin No. 77.....	6,800	6,500
Bulletin No. 78.....	6,000	6,000
Bulletin No. 79.....	1,000	1,000
Bulletin No. 80.....	2,000	1,320
Bulletin No. 81.....	4,000	3,000
Bulletin No. 82.....	4,500	2,500

<sup>a</sup> Where the number distributed is greater than the number received, the difference is accounted for by the number on hand at the beginning of the year.

<sup>b</sup> Miscellaneous publications printed prior to July 1, 1904.



*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distrib- uted.
BUREAU OF ANIMAL INDUSTRY—continued.		
Bulletin No. 84.....	10, 000	6, 200
Bulletin No. 86.....	2, 000	716
Circular No. 1, revised.....	1, 000	783
Circular No. 5.....	3, 500	1, 703
Circular No. 47.....	500	250
Circular No. 48 (reprint).....	1, 000	500
Circular No. 51 (reprint).....	2, 000	400
Circular No. 54 (reprint).....	1, 000	500
Circular No. 60 (reprint).....	500	146
Circular No. 64.....	500	500
Circular No. 65.....	2, 000	600
Circular No. 66.....	500	300
Circular No. 67.....	1, 500	1, 100
Circular No. 68.....	2, 000	705
Circular No. 69.....	1, 000	570
Circular No. 70.....	2, 000	1, 000
Circular No. 71.....	2, 000	1, 050
Circular No. 72.....	1, 000	1, 000
Circular No. 74 (reprint).....	4, 000	2, 900
Circular No. 75 (reprint).....	1, 500	2, 300
Circular No. 76.....	3, 000	1, 500
Circular No. 77.....	1, 000	200
Circular No. 81.....	2, 000	900
Circular No. 82.....	3, 500	3, 500
Circular No. 83.....	2, 000	1, 150
Circular No. 84.....	1, 000	1, 000
Circular No. 85.....	2, 000	1, 700
Circular No. 86.....	2, 000	1, 150
Circular No. 87.....	2, 000	903
Circular No. 88.....	1, 000	720
Circular No. 89.....	8, 000	7, 200
Circular No. 90.....	9, 500	2, 700
Circular No. 91.....	1, 000	650
Circular No. 92.....	500	500
Circular No. 93.....	3, 000	3, 000
Circular No. 94.....	2, 000	420
Circular No. 95.....	2, 800	2, 800
BIOLOGICAL SURVEY.		
Report of the Chief, 1905.....	1, 500	500
Bulletin No. 8 (reprint).....	1, 000	30
Bulletin No. 21.....	5, 000	4, 550
Bulletin No. 22.....	5, 000	3, 700
Bulletin No. 23.....	5, 000	3, 000
Bulletin No. 24.....	5, 000	3, 650
Bulletin No. 25.....	5, 000	1, 207
Circular No. 17 (reprint).....	1, 000	300
Circular No. 29 (reprint).....	1, 000	250
Circular No. 30.....	1, 000	200
Circular No. 43.....	2, 500	1, 650
Circular No. 49.....	1, 000	1, 000
Circular No. 50.....	2, 000	1, 800
Circular No. 51.....	1, 000	860
Circular No. 52.....	4, 000	2, 500
North American Fauna, No. 25.....	1, 000	1, 000
BUREAU OF CHEMISTRY.		
Report of the chemist, 1905.....	500	230
Bulletin No. 46 (reprint).....	500	270
Bulletin No. 62 (reprint).....	250	220
Bulletin No. 64 (reprint).....	1, 000	510
Bulletin No. 65.....	1, 000	540
Bulletin No. 66, revised.....	500	40
Bulletin No. 69, part 1, revised.....	2, 800	2, 140
Bulletin No. 69, part 2, revised.....	2, 800	2, 110
Bulletin No. 69, part 3, revised.....	2, 800	2, 420
Bulletin No. 69, part 4, revised.....	2, 800	1, 914
Bulletin No. 69, part 5, revised.....	2, 800	1, 950
Bulletin No. 69, part 6, revised.....	2, 800	1, 900
Bulletin No. 69, part 7, revised.....	2, 800	2, 050
Bulletin No. 69, part 8, revised.....	2, 800	2, 060
Bulletin No. 71 (reprint).....	1, 000	300
Bulletin No. 73 (reprint).....	250	250
Bulletin No. 74 (reprint).....	1, 000	765
Bulletin No. 78 (reprint).....	1, 000	300
Bulletin No. 80 (reprint).....	500	325
Bulletin No. 81 (reprint).....	250	100

*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distrib- uted.
BUREAU OF CHEMISTRY—continued.		
Bulletin No. 82 (reprint).....	500	50
Bulletin No. 84, part 1.....	1,000	500
Bulletin No. 90.....	1,800	1,040
Bulletin No. 91.....	3,000	2,734
Bulletin No. 92.....	500	400
Bulletin No. 93.....	6,500	5,850
Bulletin No. 94.....	3,000	1,800
Bulletin No. 95.....	3,000	2,100
Bulletin No. 96.....	3,000	2,450
Bulletin No. 97.....	2,500	1,800
Bulletin No. 100.....	7,000	3,660
Report on Soils (reprint from Chemistry Bul. 90).....	200	200
Summary of Experiments on the Relation of Soil Acidity to Fertility (reprint from Chemistry Bul. 90).....	200	200
Circular No. 10, revised.....	2,500	1,840
Circular No. 14.....	2,000	1,154
Circular No. 15.....	1,000	1,000
Circular No. 22.....	250	150
Circular No. 23 (reprint).....	300	400
Circular No. 24.....	2,500	1,000
Circular No. 25.....	2,000	2,000
Circular No. 26.....	2,500	1,850
Circular No. 27.....	1,500	1,500
Circular No. 28.....	2,000	1,770
Circular No. 29.....	1,800	1,380
Preliminary Report on the Unification of Terms for Reporting Analytical Results.....	500	500
Food Inspection Decisions, 1-25.....	7,000	7,000
Food Inspection Decisions, 26.....	6,500	6,500
Food Inspection Decisions, 27-30.....	8,500	8,500
Food Inspection Decisions, 31.....	7,000	7,000
Food Inspection Decisions, 32.....	7,000	7,000
Food Inspection Decisions, 33-36.....	7,000	7,000
Food Inspection Decisions, 37-38.....	10,000	10,000
Food Inspection Decisions, 39.....	10,000	10,000
Standards of Purity for Food Products.....	2,000	2,000
BUREAU OF ENTOMOLOGY.		
Bulletin No. 1, N. S., third edition.....	2,000	1,137
Bulletin No. 3 (reprint).....	1,000	500
Bulletin No. 4 (reprint).....	1,000	500
Bulletin No. 5 (reprint).....	500	240
Bulletin No. 22 (reprint).....	500	30
Bulletin No. 25 (reprint).....	1,000	700
Bulletin No. 28 (reprint).....	500	300
Bulletin No. 33 (reprint).....	500	200
Bulletin No. 34 (reprint).....	500	550
Bulletin No. 37 (reprint).....	500	270
Bulletin No. 42 (reprint).....	1,500	500
Bulletin No. 45 (reprint).....	500	400
Bulletin No. 47, revised edition.....	500	370
Bulletin No. 50.....	1,000	500
Bulletin No. 51.....	11,000	10,060
Bulletin No. 52.....	1,500	1,100
Bulletin No. 53.....	1,000	600
Bulletin No. 54.....	3,530	2,650
Bulletin No. 55.....	8,000	6,382
Bulletin No. 56.....	4,000	2,505
Bulletin No. 57.....	2,000	1,900
Bulletin No. 58, part 1.....	3,000	500
Some Observations on the Cotton Boll Weevil (reprint from Entomological Bulletin No. 52).....	200	200
Cold Storage for Cowpeas (reprint from Entomological Bulletin No. 54).....	400	400
Bulletin No. 10, Technical Series.....	2,000	1,631
Bulletin No. 11, Technical Series.....	2,000	1,500
Bulletin No. 12, part 1, Technical Series.....	2,000	500
Bibliography of the More Important Contributions to American Economic Entomology, Part VIII.....	1,000	850
Circular No. 1 (reprint).....	500	5
Circular No. 20 (reprint).....	3,000	100
Circular No. 21 (reprint).....	2,000	350
Circular No. 37 (reprint).....	500	200
Circular No. 42 (reprint).....	3,000	2,150
Circular No. 43 (reprint).....	2,500	300
Circular No. 56 (reprint).....	2,000	2,309
Circular No. 57 (reprint).....	1,000	850
Circular No. 63.....	3,000	2,380
Circular No. 64.....	4,500	3,000

*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distrib- uted.
BUREAU OF ENTOMOLOGY—continued.		
Circular No. 65.....	2,700	2,400
Circular No. 66.....	3,600	2,800
Circular No. 67.....	3,500	2,500
Circular No. 68.....	3,000	2,500
Circular No. 69.....	3,000	2,500
Circular No. 70.....	3,000	2,550
Circular No. 71.....	4,000	3,100
Circular No. 72.....	3,000	1,700
Circular No. 73.....	3,000	2,600
Circular No. 74.....	7,500	6,000
FOREST SERVICE.		
Report of the Forester, 1903 (reprint).....	2,500	2,000
Report of the Forester, 1904 (reprint).....	3,000	2,600
Report of the Forester, 1905.....	2,500	2,400
Bulletin No. 10 (reprint).....	2,000	2,500
Bulletin No. 17 (reprint).....	3,000	3,000
Bulletin No. 24, part 1 (reprint).....	9,500	7,200
Bulletin No. 24, part 2 (reprint).....	2,000	7,060
Bulletin No. 26 (reprint).....	1,000	1,440
Bulletin No. 31 (reprint).....	2,000	1,370
Bulletin No. 34 (reprint).....	1,000	2,560
Bulletin No. 39 (reprint).....	2,000	2,300
Bulletin No. 45 (reprint).....	1,000	2,100
Bulletin No. 52 (reprint).....	1,500	2,110
Bulletin No. 53 (reprint).....	2,000	1,600
Bulletin No. 56.....	13,000	12,650
Bulletin No. 57.....	1,000	1,000
Bulletin No. 58.....	10,000	10,000
Bulletin No. 59.....	24,000	21,600
Bulletin No. 61.....	22,000	20,300
Bulletin No. 62.....	17,000	15,900
Bulletin No. 63.....	20,000	16,500
Bulletin No. 64.....	12,000	10,000
Bulletin No. 65.....	12,000	11,200
Bulletin No. 66.....	14,000	12,110
Bulletin No. 67.....	6,000	6,000
Bulletin No. 68.....	8,000	7,425
Bulletin No. 73.....	20,000	2,000
Circular No. 12 (reprint).....	2,000	1,300
Circular No. 21 (reprint).....	5,000	4,500
Circular No. 22 (reprint).....	10,000	5,600
Circular No. 23, third revision.....	2,000	1,500
Circular No. 25 (reprint).....	4,000	2,200
Circular No. 32 (reprint).....	1,000	2,300
Circular No. 34 (reprint).....	1,000	540
Circular No. 35.....	187,500	186,800
Circular No. 36.....	100,000	97,000
Circular No. 37.....	7,000	5,060
OFFICE OF EXPERIMENT STATIONS.		
Report of the Director, 1905.....	2,500	2,500
Annual Report of the Office of Experiment Stations, 1904.....	5,000	4,825
Bulletin No. 28, revised edition.....	3,000	1,400
Bulletin No. 43 (reprint).....	500	270
Bulletin No. 67 (reprint).....	100	75
Bulletin No. 69 (reprint).....	200	50
Bulletin No. 71 (reprint).....	250	150
Bulletin No. 75 (reprint).....	100	60
Bulletin No. 91 (reprint).....	100	60
Bulletin No. 113 (reprint).....	1,000	260
Bulletin No. 121 (reprint).....	100	50
Bulletin No. 135 (reprint).....	1,500	1,225
Bulletin No. 145 (reprint).....	2,000	1,410
Bulletin No. 147 (reprint).....	1,000	300
Bulletin No. 150.....	1,000	240
Bulletin No. 155.....	5,000	2,300
Bulletin No. 156.....	3,500	2,800
Bulletin No. 157.....	1,000	950
Bulletin No. 158.....	1,000	1,000
Bulletin No. 159.....	1,500	1,175
Bulletin No. 160.....	9,000	7,550
Bulletin No. 161.....	3,500	2,230
Bulletin No. 162.....	1,000	1,000
Bulletin No. 163.....	4,500	3,925
Bulletin No. 164.....	1,000	900
Bulletin No. 165.....	5,000	4,000



*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distributed.
OFFICE OF EXPERIMENT STATIONS—continued.		
Bulletin No. 166.....	5,000	2,400
Hawaii Experiment Station Bulletin No. 9.....	4,500	4,100
Hawaii Experiment Station Bulletin No. 10.....	5,500	5,075
Hawaii Experiment Station Bulletin No. 11.....	5,000	4,800
Hawaii Experiment Station Bulletin No. 12.....	5,000	4,600
Hawaii Experiment Station Bulletin No. 13.....	5,000	4,600
O. E. S. Doc. 538. Constitution and By-Laws of American Association of Farmers' Institute Workers (reprint from Bul. 120).....	500	50
O. E. S. Doc. 566. Dietary Studies of Groups, Especially in Public Institutions (reprint from O. E. S. Annual Report).....	1,000	250
O. E. S. Doc. 635. Constitution and By-Laws of American Association of Farmers' Institute Workers (reprint from O. E. S. Bul. 138).....	500	100
Reprints from Bulletin No. 153:		
O. E. S. Doc. 777. Report of Executive Committee.....	100	100
O. E. S. Doc. 778. Report of the Bibliographer.....	100	100
O. E. S. Doc. 779. Collective College and Station Exhibit at St. Louis.....	100	100
O. E. S. Doc. 780. Problems in the College of Agriculture and Mechanic Arts.....	300	300
O. E. S. Doc. 781. The Social Phase of Agricultural Education.....	200	200
O. E. S. Doc. 782. The Upbuilding of Agriculture.....	300	300
O. E. S. Doc. 783. How Far should or may Land-Grant Colleges Engage in Teaching Elementary Subjects.....	500	500
O. E. S. Doc. 784. Military Instruction.....	200	200
O. E. S. Doc. 785. Military Instruction.....	500	500
O. E. S. Doc. 786. What Degrees should be given for Undergraduate Courses, etc.....	500	500
O. E. S. Doc. 787. What can and should be done to Increase the Interest in Application of the Agricultural Side of Technical Education.....	500	500
O. E. S. Doc. 788. Plant Breeding.....	500	500
O. E. S. Doc. 789. Animal Breeding.....	500	500
O. E. S. Doc. 790. How much Teaching, if any, is it Desirable that a Station Worker should do.....	500	500
Reprints from Annual Report, Office of Experiment Stations, 1904:		
O. E. S. Doc. 797. Annual Report of the Hawaii Agricultural Experiment Station, 1904.....	1,000	755
O. E. S. Doc. 803. Progress of Agricultural Education, 1904.....	1,000	250
O. E. S. Doc. 805. County Schools of Agriculture in Wisconsin.....	500	500
O. E. S. Doc. 806. Exhibits at the Louisiana Purchase Exposition.....	200	200
Reprints from O. E. S. Bulletin 158:		
Separate No. 1. Review of the Irrigation Work of the Year 1904.....	4,000	2,965
Separate No. 2. Irrigation in Santa Clara Valley, California.....	3,000	2,600
Separate No. 3. The Distribution and Use of Water, etc.....	3,000	2,180
Separate No. 4. Irrigation in Klamath County, Oregon.....	2,000	1,600
Separate No. 5. Irrigation Investigation at the New Mexico Experiment Station, etc.....	2,000	1,750
Separate No. 6. Irrigation in Southern Texas.....	1,000	1,000
Separate No. 7. Rice Irrigation in Louisiana, Texas, and Arkansas, 1903-4.....	2,000	1,580
Separate No. 8. Irrigation Experiments at Fort Hays, Kansas.....	2,000	1,500
Separate No. 9. Report on Drainage Investigations, 1904.....	3,000	3,000
O. E. S. Doc. 854. Results of Investigations (reprint from O. E. S. Bul. 157).....	2,000	600
O. E. S. Doc. 855. Water Rights Within the States (reprint from O. E. S. Bul. 157).....	2,000	800
O. E. S. Doc. 877. Publications of the Office of Experiment Stations during 1888-1899, etc. (reprint from Bul. 80).....	1,000	900
O. E. S. Doc. 878. Publications of Office of Experiment Stations, issued during 1900 and 1901, etc.....	500	500
O. E. S. Doc. 879. Publications of Office of Experiment Stations, issued during 1902, etc. (reprint from Annual Report O. E. S., 1902).....	500	300
O. E. S. Doc. 880. Publications of the Office of Experiment Stations issued during 1903, etc. (reprint from Annual Report O. E. S. 1903).....	500	250
O. E. S. Doc. 881. Publications of the Office of Experiment Stations issued during 1904, etc. (reprint from Annual Report O. E. S. 1904).....	500	350
O. E. S. Doc. 884. New Horticultural Building at the Massachusetts College of Agriculture (reprint from Experiment Station Record, Vol. 17, No. 7).....	250	155
Reprints from Bulletin No. 164:		
O. E. S. Doc. 891. Annual address of the president of the association.....	50	50
O. E. S. Doc. 892. Memorial to President H. H. Goodell.....	200	200
O. E. S. Doc. 893. Courses in Agriculture, Horticulture, and Allied Subjects.....	200	200
O. E. S. Doc. 894. The Relation of the Land-Grant Colleges to the State Universities.....	500	500
Circular No. 46, revised.....	2,000	1,210
Circular No. 51.....	2,000	1,500
Circular No. 62.....	4,000	3,650
Circular No. 64.....	1,000	800
Circular No. 65.....	3,000	2,600
Circular No. 66.....	1,200	360
Experiment Station Record:		
Vol. 1, No. 2 (reprint).....	200	50
Vol. 2, No. 3 (reprint).....	200	20

*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distributed.
OFFICE OF EXPERIMENT STATIONS—continued.		
Experiment Station Record—Continued.		
Vol. 2, No. 4 (reprint).....	200	25
Vol. 2, No. 5 (reprint).....	200	25
Vol. 2, No. 6 (reprint).....	200	20
Vol. 2, No. 7 (reprint).....	200	20
Vol. 2, No. 11 (reprint).....	200	25
Vol. 3, No. 1 (reprint).....	200	20
Vol. 3, No. 2 (reprint).....	200	10
Vol. 4, No. 8 (reprint).....	200	10
Vol. 4, No. 11 (reprint).....	200	15
Vol. 6, No. 1 (reprint).....	200	21
Vol. 7, No. 5 (reprint).....	200	10
Vol. 10, No. 4 (reprint).....	200	19
Vol. 15, No. 12 (reprint).....	200	25
Vol. 16, bound.....	250	250
Vol. 16, No. 1 (reprint).....	500	60
Vol. 16, No. 2 (reprint).....	500	100
Vol. 16, No. 3 (reprint).....	500	50
Vol. 16, No. 4 (reprint).....	500	300
Vol. 16, No. 11.....	6, 500	5, 675
Vol. 16, No. 12.....	6, 500	6, 225
Vol. 17, No. 1.....	6, 500	5, 900
Vol. 17, No. 2.....	6, 500	6, 310
Vol. 17, No. 3.....	6, 500	5, 850
Vol. 17, No. 4.....	6, 500	6, 050
Vol. 17, No. 5.....	6, 500	6, 100
Vol. 17, No. 6.....	6, 500	6, 080
Vol. 17, No. 7.....	6, 500	6, 000
Vol. 17, No. 8.....	6, 500	5, 500
Vol. 17, No. 9.....	6, 500	6, 050
Experiment Station Work:		
Vol. II, No. 10.....	3, 000	3, 000
Vol. II, No. 11.....	3, 000	3, 000
Vol. II, No. 12.....	3, 000	3, 000
Vol. II, No. 13.....	3, 000	3, 000
Vol. II, No. 14.....	3, 000	3, 000
Alaska Agricultural Experiment Station, Bulletin No. 3.....	5, 000	5, 000
Porto Rico Agricultural Experiment Station, Bulletin No. 5 (English edition).....	2, 000	2, 000
Porto Rico Agricultural Experiment Station, Bulletin No. 5 (Spanish edition).....	2, 000	2, 000
Porto Rico Agricultural Experiment Station, Bulletin No. 6 (English edition).....	2, 000	2, 000
Porto Rico Agricultural Experiment Station, Bulletin No. 6 (Spanish edition).....	3, 000	3, 000
LIBRARY.		
Report of the Librarian, 1905.....	500	100
Bulletin No. 55.....	1, 000	500
Bulletin No. 56.....	1, 000	950
Bulletin No. 57.....	1, 000	950
Bulletin No. 58.....	1, 000	900
Bulletin No. 59.....	900	745
BUREAU OF PLANT INDUSTRY.		
Report of the Chief, 1905.....	500	300
Bulletin No. 43 (reprint).....	1, 000	250
Bulletin No. 54 (reprint).....	500	300
Bulletin No. 56 (reprint).....	1, 000	610
Bulletin No. 59 (reprint).....	1, 000	110
Bulletin No. 66 (reprint).....	200	200
Bulletin No. 72 (reprint).....	500	1, 197
Bulletin No. 74.....	1, 000	310
Bulletin No. 75.....	1, 000	600
Bulletin No. 76.....	1, 000	300
Bulletin No. 77.....	3, 000	1, 900
Bulletin No. 78.....	1, 000	1, 000
Bulletin No. 79.....	2, 000	1, 100
Bulletin No. 80.....	2, 000	1, 525
Bulletin No. 81.....	3, 500	2, 700
Bulletin No. 82.....	5, 500	4, 500
Bulletin No. 83.....	4, 000	2, 650
Bulletin No. 84.....	4, 000	3, 800
Bulletin No. 85.....	5, 000	4, 180
Bulletin No. 86.....	4, 500	2, 675
Bulletin No. 87.....	2, 500	1, 950
Bulletin No. 88.....	2, 500	1, 700
Bulletin No. 89.....	4, 500	4, 500
Bulletin No. 90.....	2, 000	1, 513
Bulletin No. 90, part 1.....	2, 500	2, 500
Bulletin No. 90, part 2.....	2, 500	2, 025
Bulletin No. 90, part 3.....	3, 500	3, 400

*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distrib- uted.
BUREAU OF PLANT INDUSTRY—continued.		
Bulletin No. 90, part 4 .....	2,000	1,500
Bulletin No. 91 .....	12,000	5,450
Bulletin No. 93 .....	10,000	9,425
Bulletin No. 100, part 1 .....	2,000	1,600
Bulletin No. 100, part 2 .....	2,500	2,500
Bulletin No. 100, part 3 .....	2,500	1,500
Bulletin No. 100, part 4 .....	4,500	1,000
<i>Agrostology.</i>		
Bulletin No. 14 (revised) .....	1,000	215
Bulletin No. 20 (reprint) .....	500	372
<i>Botany.</i>		
Circular No. 12 (reprint) .....	1,000	475
Circular No. 18 (reprint) .....	1,000	300
Circular No. 21 (reprint) .....	500	300
<i>Vegetable Physiology and Pathology.</i>		
Bulletin No. 27 (reprint) .....	500	200
DIVISION OF PUBLICATIONS.		
Report of the Editor, 1905 .....	1,500	200
Circular No. 1 (revised) .....	2,500	1,500
List of Publications for Free Distribution by the Department of Agriculture (No. 247, thirteenth edition, revised) .....	10,000	10,000
List of Publications for Free Distribution by the Department of Agriculture (No. 247, fourteenth edition, revised) .....	10,000	6,000
List of Publications for Sale by the Superintendent of Documents of the De- partment of Agriculture (No. 179, thirteenth edition) .....	10,000	8,000
Monthly List of Publications, June, 1905 .....	148,000	148,000
Foreign Monthly List of Publications, June, 1905 .....	2,500	2,500
Monthly List of Publications, July, 1905 .....	148,000	148,000
Foreign Monthly List of Publications, July, 1905 .....	3,000	3,000
Monthly List of Publications, August, 1905 .....	155,000	155,000
Foreign Monthly List of Publications, August, 1905 .....	2,500	2,500
Monthly List of Publications, September, 1905 .....	155,000	155,000
Foreign Monthly List of Publications, September, 1905 .....	2,500	2,500
Monthly List of Publications, October, 1905 .....	175,000	175,000
Foreign Monthly List of Publications, October, 1905 .....	3,000	3,000
Monthly List of Publications, November, 1905 .....	175,000	175,000
Foreign Monthly List of Publications, November, 1905 .....	3,000	3,000
Monthly List of Publications, December, 1905 .....	175,000	175,000
Foreign Monthly List of Publications, December, 1905 .....	3,000	3,000
Monthly List of Publications, January, 1906 .....	180,000	180,000
Foreign Monthly List of Publications, January, 1906 .....	3,000	3,000
Monthly List of Publications, February, 1906 .....	185,000	185,000
Foreign Monthly List of Publications, February, 1906 .....	3,000	3,000
Monthly List of Publications, March, 1906 .....	185,000	185,000
Foreign Monthly List of Publications, March, 1906 .....	3,000	3,000
Monthly List of Publications, April, 1906 .....	185,000	185,000
Foreign Monthly List of Publications, April, 1906 .....	3,000	3,000
Monthly List of Publications, May, 1906 .....	200,000	200,000
Foreign Monthly List of Publications, May, 1906 .....	3,000	3,000
OFFICE OF PUBLIC ROADS.		
Report of Director, 1905 .....	2,500	400
Circular No. 38 .....	5,000	3,500
Circular No. 39 .....	4,000	3,610
Circular No. 40 .....	5,000	4,625
Circular No. 41 .....	5,000	4,000
Circular No. 42 .....	5,000	3,800
Circular No. 43 .....	5,000	2,500
Circular No. 44 .....	5,000	3,500
Circular No. 45 .....	5,000	2,500
Circular No. 46 .....	5,000	3,100
Circular No. 47 .....	6,000	5,100
Circular No. 48 .....	5,000	3,430
Circular No. 49 .....	6,000	3,030
Circular No. 50 .....	10,000	1,525
BUREAU OF STATISTICS.		
Report of the Statistician, 1905 .....	2,500	60
Bulletin No. 34 .....	20,000	5,600
Bulletin No. 35 .....	5,000	4,500
Bulletin No. 36 .....	5,000	4,398



*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distrib- uted.
BUREAU OF STATISTICS—continued.		
Bulletin No. 37.....	4,800	4,800
Bulletin No. 38.....	5,400	4,900
Bulletin No. 39.....	9,600	9,600
Bulletin No. 40.....	10,000	10,000
Bulletin No. 41.....	10,000	10,000
Crop Reporter:		
Vol. 1, No. 8, December, 1899 (reprint) .....	300	300
Vol. 7, No. 3, July, 1905.....	105,000	105,000
Vol. 7, No. 4, August, 1905.....	105,000	105,000
Vol. 7, No. 5, September, 1905.....	105,000	105,000
Vol. 7, No. 6, October, 1905.....	105,000	105,000
Vol. 7, No. 7, November, 1905.....	105,000	105,000
Vol. 7, No. 8, December, 1905.....	105,000	105,000
Vol. 7, No. 8, December, 1905, supplement.....	107,000	107,000
Vol. 7, No. 9, January, 1906.....	105,000	105,000
Vol. 7, No. 10, February, 1906.....	105,000	105,000
Vol. 7, No. 11, March, 1906.....	105,000	105,000
Vol. 7, No. 12, April, 1906.....	105,000	105,000
Vol. 8, No. 1, May, 1906.....	105,000	105,000
Vol. 8, No. 2, June, 1906.....	105,000	105,000
BUREAU OF SOILS.		
Report of Chief, 1905.....	200	100
Bulletin No. 10.....	500	85
Bulletin No. 23.....	800	300
Bulletin No. 26.....	1,000	350
Bulletin No. 28.....	3,000	2,079
Bulletin No. 29.....	6,000	4,150
Bulletin No. 30.....	3,300	2,960
Bulletin No. 31.....	2,500	2,500
Bulletin No. 32.....	2,500	2,242
Bulletin No. 34.....	2,500	1,500
Circular No. 10.....	1,000	100
Circular No. 13, revised.....	10,000	7,400
Circular No. 17.....	3,500	2,210
Circular No. 18.....	2,500	2,500
Report of Field Operations for 1904.....	6,000	586
Advance Sheets of Field Operations for 1904:		
Soil Survey of Macon County, Alabama.....	1,000	400
Soil Survey of Sumter County, Alabama.....	1,000	300
Soil Survey of Yuma Area, Arizona and California.....	1,000	500
Soil Survey of Bakersfield Area, California.....	1,000	400
Soil Survey of San Bernardino Valley, California.....	1,000	500
Soil Survey of Gainesville Area, Florida.....	1,000	300
Soil Survey of Dodge County, Georgia.....	1,000	400
Soil Survey of O'Fallon Area, Illinois and Missouri.....	1,000	300
Soil Survey of Boonville Area, Indiana.....	1,000	300
Soil Survey of Marshall County, Indiana.....	1,000	275
Soil Survey of Scott County, Indiana.....	1,000	450
Soil Survey of Tama County, Iowa.....	1,000	450
Soil Survey of Allen County, Kansas.....	1,000	400
Soil Survey of Garden City Area, Kansas.....	1,000	300
Soil Survey of Warren County, Kentucky.....	1,000	400
Soil Survey of De Soto Parish, Louisiana.....	1,000	734
Soil Survey of Alma Area, Michigan.....	1,000	340
Soil Survey of Munising Area, Michigan.....	1,000	770
Soil Survey of Owosso Area, Michigan.....	1,000	375
Soil Survey of Saginaw Area, Michigan.....	1,000	412
Soil Survey of Superior Area, Minnesota and Wisconsin.....	1,000	500
Soil Survey of Biloxi Area, Mississippi.....	1,000	850
Soil Survey of Jackson Area, Mississippi.....	1,000	200
Soil Survey of Webster County, Missouri.....	1,000	288
Soil Survey of Kearney Area, Nebraska.....	1,000	350
Soil Survey of Auburn Area, New York.....	1,000	700
Soil Survey of Vergennes Area, New York and Vermont.....	1,000	425
Soil Survey of Greeneville Area, North Carolina and Tennessee.....	1,000	400
Soil Survey of Cando Area, North Dakota.....	1,000	850
Soil Survey of Coshocton County, Ohio.....	1,000	400
Soil Survey of Wooster Area, Ohio.....	1,000	300
Soil Survey of Adams County, Pennsylvania.....	1,000	540
Soil Survey of Rhode Island Area, Pennsylvania.....	1,000	440
Soil Survey of Charleston Area, South Carolina.....	1,000	300
Soil Survey of Lancaster County, South Carolina.....	1,000	240
Soil Survey of Lawrence County, Tennessee.....	1,000	300
Soil Survey of Anderson County, Texas.....	1,000	286
Soil Survey of Austin Area, Texas.....	1,000	339
Soil Survey of San Antonio Area, Texas.....	1,000	400

*Publications other than Farmers' Bulletins received and distributed from July 1, 1905, to June 30, 1906—Continued.*

Publications.	Received.	Distrib- uted.
BUREAU OF SOILS—continued.		
Advance Sheets of Field Operations for 1905:		
Soil Survey of Montgomery County, Alabama.....	1, 000	325
Soil Survey of Lauderdale County, Alabama.....	1, 000	375
Soil Survey of Dallas County, Alabama.....	1, 000	300
Soil Survey of Blount County, Georgia.....	1, 000	300
Soil Survey of Spalding County, Georgia.....	1, 000	310
Soil Survey of Westerville Area, Ohio.....	1, 000	318
Soil Survey of East Baton Rouge Parish, Louisiana.....	1, 000	500
Soil Survey of Crystal Springs Area, Mississippi.....	1, 000	300
Soil Survey of Duplin County, North Carolina.....	1, 000	600
Soil Survey of Lavaca County, Texas.....	1, 000	300
Soil Survey of Waco Area, Texas.....	1, 000	300
OFFICE OF THE SECRETARY.		
Preliminary Report of the Secretary, 1905.....	2, 000	5, 000
Special Report No. 81.....	81, 000	81, 000
Special Report No. 82.....	2, 000	600
Circular No. 14.....	40, 000	40, 000
Circular No. 15.....	40, 000	34, 600
Circular No. 16.....	8, 000	4, 734
Circular No. 17.....	12, 000	9, 250
Circular No. 18.....	5, 000	2, 285
Yearbook for 1905.....	150	150
Annual Report of the Department, 1905.....	3, 000	1, 500
Report on the New Department Building, 1905 (reprint from Annual Report, 1905).....	250	250
<i>Extracts from Yearbooks.</i>		
No. 37, part 2. The Meadow Lark and Baltimore Oriole.....	2, 500	900
No. 47. Small Fruit Culture for Market.....	2, 600	700
No. 213. Value of Potatoes as Food.....	1, 000	750
No. 230. Commercial Apple Orchardling.....	1, 000	950
No. 254. The Hemp Industry in the United States.....	1, 000	650
No. 270. Practice of Forest Planting in the United States.....	3, 000	2, 000
No. 274. Influence of Forestry upon the Lumber Industry.....	1, 000	1, 050
No. 290. Fertilizers for Special Crops.....	500	900
No. 296. Use of Mineral Oil in Road Improvements.....	1, 000	1, 310
No. 309. Economic Value of the Bobwhite.....	2, 500	1, 500
No. 312. The Farmers' Institute.....	300	800
No. 315. Recent Progress in Timber Preservatives.....	1, 000	1, 000
No. 322. Some New Facts about the Migration of Birds.....	1, 500	1, 263
No. 323. The Model Farm.....	1, 000	1, 000
No. 324. Wheat Flour and Bread.....	1, 000	2, 000
No. 332. Building Sand-clay Roads in the United States.....	1, 000	1, 000
No. 337. Attitude of Lumbermen Toward Forest Fires.....	1, 000	16, 000
No. 340. Opportunities in Agriculture.....	1, 000	2, 900
No. 341. Present Status of Cotton Boll Weevil in the United States.....	250	200
No. 343. New Citrus Creations of the Department of Agriculture.....	8, 000	8, 000
No. 348. The Nut Weevils.....	500	310
No. 350. Practical Road Building in Madison County, Tennessee.....	5, 000	8, 160
No. 351. Sugar-Beet Seed Breeding.....	750	444
No. 353. Detection of Cotton Seed Oil in Lard.....	300	200
No. 356. Promising New Fruits.....	5, 000	1, 600
No. 358. Improving of Tobacco by Breeding and Selection.....	6, 000	3, 000
No. 359. The Determination of Timber Values.....	500	500
No. 362. Boys' Agricultural Clubs.....	5, 500	5, 265
No. 366. Annual Breeding and Feeding Investigations by Bureau of Animal Industry.....	1, 000	750
No. 369. Directory for Farmers with Weather Conditions, Crop Injuries, etc.....	10, 000	8, 200
No. 372. Progress of Forestry in 1904.....	1, 000	30, 550
No. 390. Renovated Butter, etc.....	500	6
No. 400. Causes Affecting Farm Values.....	500	5
No. 402. Federal Game Protection: A Five Years' Retrospect.....	5, 000	700
WEATHER BUREAU.		
Report of the Chief, 1905.....	2, 500	2, 500

*Farmers' Bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1905-6.*

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen. <sup>a</sup>	Miscellaneous distribution. <sup>a</sup>
22	The Feeding of Farm Animals	77,750	64,476	19,336
24	Hog Cholera and Swine Plague	46,600	34,807	12,289
25	Peanuts: Culture and Uses	20,100	13,167	12,152
27	Flax for Seed and Fiber		3,999	3,514
28	Weeds: And How to Kill Them	60,000	45,068	18,702
29	Souring and Other Changes in Milk	35,400	27,341	11,590
30	Grape Diseases on the Pacific Coast		4,710	3,615
32	Silos and Silage	36,100	23,064	9,273
33	Peach Growing for Market	20,000	14,798	9,341
34	Meats: Composition and Cooking	41,700	25,352	13,239
35	Potato Culture	61,000	41,326	19,674
36	Cotton Seed and Its Products	13,816	10,358	4,643
37	Kafir Corn: Culture and Uses	18,000	12,429	7,442
38	Spraying for Fruit Diseases	10,800	9,508	6,958
39	Onion Culture	32,250	21,989	15,644
41	Fowls: Care and Feeding	106,500	77,717	29,501
42	Facts About Milk	20,700	18,984	11,185
43	Sewage Disposal on the Farm	15,000	10,336	8,269
44	Commercial Fertilizers	35,800	23,531	12,269
45	Some Insects Injurious to Stored Grain		3,261	1,328
46	Irrigation in Humid Climates		4,660	4,297
47	Insects Affecting the Cotton Plant	25,000	16,661	3,428
48	The Manuring of Cotton	26,200	21,318	5,884
49	Sheep Feeding	36,000	24,935	10,430
50	Sorghum as a Forage Crop		6,052	4,022
51	Standard Varieties of Chickens	90,000	73,020	24,175
52	The Sugar Beet	22,100	16,091	7,730
54	Some Common Birds	29,100	15,956	15,381
55	The Dairy Herd	40,900	31,573	13,136
56	Experiment Station Work—I	11,100	8,234	7,338
57	Butter Making on the Farm	20,600	13,061	7,539
58	The Soy Bean as a Forage Crop	10,000	9,907	7,467
59	Bee Keeping	41,200	22,134	16,912
60	Methods of Curing Tobacco		10,779	4,401
61	Asparagus Culture	25,425	19,450	11,704
62	Marketing Farm Produce	36,050	24,902	12,080
63	Care of Milk on the Farm	35,600	24,501	10,736
64	Ducks and Geese	35,200	21,261	15,091
65	Experiment Station Work—II	10,500	8,590	8,012
66	Meadows and Pastures	23,483	17,686	8,542
68	The Black Rot of the Cabbage	10,200	12,167	7,969
69	Experiment Station Work—III	10,000	11,551	6,582
70	Insect Enemies of the Grape	5,000	7,486	8,122
71	Essentials in Beef Production	35,000	29,081	7,617
72	Cattle Ranges of the Southwest	7,000	7,253	3,493
73	Experiment Station Work—IV	21,000	12,184	6,887
74	Milk as Food	30,775	19,842	16,086
77	The Liming of Soils	25,400	14,981	13,581
78	Experiment Station Work—V	25,800	16,002	7,242
79	Experiment Station Work—VI	26,100	11,245	7,478
80	The Peach Twig-borer	10,000	10,785	6,297
81	Corn Culture in the South	36,300	35,407	7,208
82	The Culture of Tobacco	20,400	18,737	5,684
83	Tobacco Soils	20,400	14,746	4,011
84	Experiment Station Work—VII	10,000	11,214	9,688
85	Fish as Food	36,800	18,405	11,066
86	Thirty Poisonous Plants	21,300	14,853	12,474
87	Experiment Station Work—VIII	21,600	10,519	6,752
88	Alkali Lands		10,905	4,056
91	Potato Diseases and Treatment	50,000	36,607	14,770
92	Experiment Station Work—IX	26,250	13,309	5,566
93	Sugar as Food	13,000	11,839	11,552
94	The Vegetable Garden	66,200	44,651	21,549
95	Good Roads for Farmers	81,000	70,688	11,844
96	Raising Sheep for Mutton	45,000	32,423	7,330
97	Experiment Station Work—X	10,000	8,211	6,962
98	Suggestions to Southern Farmers	35,400	31,763	4,898
99	Insect Enemies of Shade Trees	10,000	10,488	7,129
100	Hog Raising in the South	36,125	29,487	6,638
101	Millet	21,640	10,362	6,366
102	Southern Forage Plants	25,900	20,525	5,375
103	Experiment Station Work—XI	10,000	7,010	6,439
104	Notes on Frost	15,500	8,991	8,437
105	Experiment Station Work—XII	10,000	8,513	6,061
106	Breeds of Dairy Cattle	65,318	51,002	14,316
107	Experiment Station Work—XIII	10,800	8,598	5,548
108	Saltbushes		2,313	2,913
109	Farmers' Reading Courses	35,000	30,582	11,497

<sup>a</sup> Where the number distributed is greater than the number received, the difference is accounted for by the number on hand at the beginning of the year.



*Farmers' Bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1905-6—Continued.*

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
110	Rice Culture in the United States.....		3,733	3,979
111	Farmers' Interest in Good Seed.....	35,800	30,510	11,588
112	Bread and Bread Making.....	50,750	33,665	17,085
113	The Apple and How to Grow It.....	53,250	40,526	17,268
114	Experiment Station Work—XIV.....	10,500	16,301	10,306
115	Hop Culture in California.....		1,515	2,141
116	Irrigation in Fruit Growing.....	20,000	13,848	5,862
118	Grape Growing in the South.....	25,900	21,132	6,149
119	Experiment Station Work—XV.....	10,800	11,223	5,542
120	Insects Affecting Tobacco.....		9,688	2,518
121	Beans, Peas, and Other Legumes as Food.....	30,500	17,111	13,609
122	Experiment Station Work—XVI.....	10,000	9,833	6,720
123	Red Clover Seed: Information for Purchasers.....	10,800	8,044	6,555
124	Experiment Station Work—XVII.....		11,159	5,795
125	Protection of Food Products from Injurious Temperatures.....			
	Practical Suggestions for Farm Buildings.....	20,000	8,281	6,541
126	Important Insecticides.....	72,600	60,493	16,958
127	Eggs and Their Uses as Food.....	15,000	12,542	9,349
128	Sweet Potatoes.....	41,000	28,416	17,135
129	Sweet Potatoes.....	25,000	21,256	12,018
131	Household Tests for Detection of Oleomargarine and Renovated Butter.....	15,000	13,160	5,925
132	Insect Enemies of Growing Wheat.....	20,000	16,818	6,428
133	Experiment Station Work—XVIII.....	10,000	11,078	6,186
134	Tree Planting in Rural School Grounds.....	30,500	25,175	11,672
135	Sorghum Sirup Manufacture.....	10,125	15,060	5,023
136	Earth Roads.....	50,200	40,323	9,952
137	The Angora Goat.....	25,000	21,156	10,937
138	Irrigation in Field and Garden.....	11,050	13,180	7,355
139	Emmer: A Grain for the Semiarid Regions.....		9,040	3,514
140	Pineapple Growing.....		2,219	2,904
141	Poultry Raising on the Farm.....	115,600	93,344	31,760
142	Principles of Nutrition and Nutritive Value of Food.....	32,600	25,236	16,840
143	The Conformation of Beef and Dairy Cattle.....	25,600	32,085	6,747
144	Experiment Station Work—XIX.....	21,600	16,579	6,779
145	Carbon Bisulphid as an Insecticide.....	10,000	4,595	6,111
146	Insecticides and Fungicides.....	10,000	13,095	7,871
147	Winter Forage Crops for the South.....	25,000	20,473	4,527
148	Celery Culture.....	35,900	22,759	13,141
149	Experiment Station Work—XX.....	20,500	16,061	4,439
150	Clearing New Land.....	20,600	15,652	8,211
151	Dairying in the South.....	10,200	15,853	5,102
152	Scabies in Cattle.....	15,800	15,001	5,857
153	Orchard Enemies in the Pacific Northwest.....	10,050	6,240	3,622
154	The Home Fruit Garden: Preparation and Care.....	68,300	55,989	17,067
155	How Insects Affect Health in Rural Districts.....	37,000	28,378	9,445
156	The Home Vineyard.....	25,200	23,256	11,204
157	The Propagation of Plants.....	26,400	20,188	11,996
158	How to Build Small Irrigation Ditches.....		13,554	6,454
159	Scab in Sheep.....	17,000	18,341	4,993
161	Practical Suggestions for Fruit Growers.....	62,100	50,202	12,316
162	Experiment Station Work—XXI.....	25,800	34,841	6,688
164	Rape as a Forage Crop.....	14,800	11,376	6,316
165	Culture of the Silkworm.....		2,144	4,750
166	Cheese Making on the Farm.....	10,800	16,465	7,626
167	Cassava.....	10,500	2,849	2,995
168	Pearl Millets.....		13,378	3,214
169	Experiment Station Work—XXII.....	30,600	26,922	5,992
170	Principles of Horse Feeding.....	81,800	73,477	12,893
171	The Control of the Codling Moth.....	10,000	8,074	5,460
172	Scale Insects and Mites on Citrus Trees.....		3,080	3,059
173	Primer of Forestry.....	40,000	27,535	15,042
174	Broom Corn.....		12,132	4,049
175	Home Manufacture and Use of Unfermented Grape Juice.....	20,800	14,231	13,237
176	Cranberry Culture.....		4,258	4,237
177	Squab Raising.....	35,200	19,173	18,653
178	Insects Injurious in Cranberry Culture.....		2,329	2,514
179	Horseshoeing.....	46,600	40,583	9,673
181	Pruning.....	51,250	41,324	17,817
182	Poultry as Food.....	35,750	26,953	14,476
183	Meat on the Farm—Butchering, Curing, etc.....	46,945	43,111	14,921
184	Marketing Live Stock.....	36,250	38,670	7,233
185	Beautifying Home Grounds.....	65,700	56,826	19,087
186	Experiment Station Work—XXIII.....	11,000	15,711	9,926
187	Drainage of Farm Lands.....	30,250	29,222	10,747
188	Weeds Used in Medicine.....	20,000	15,765	12,682
190	Experiment Station Work—XXIV.....	30,900	29,791	8,881
192	Barnyard Manure.....	47,100	35,300	12,490
193	Experiment Station Work—XXV.....	15,900	13,934	5,766

*Farmers' Bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1905-6—Continued.*

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
194	Alfalfa Seed .....	36,600	26,955	11,151
195	Annual Flowering Plants .....	30,000	33,417	12,746
196	Usefulness of the American Toad .....	5,000	4,966	8,103
197	Importation of Game Birds and Eggs for Propagation ..	9,900	9,174	4,640
198	Strawberries .....	51,600	42,343	17,082
199	Corn Growing .....	80,400	72,430	15,584
200	Turkeys .....	80,500	64,062	20,302
201	Cream Separators on Western Farms .....	40,400	20,936	9,194
202	Experiment Station Work—XXVI .....	21,300	16,697	7,728
203	Canned Fruits, Preserves, and Jellies .....	91,300	71,041	29,801
204	The Cultivation of Mushrooms .....	26,400	14,066	14,972
205	Pig Management .....	151,375	125,929	13,758
206	Milk Fever and Its Treatment .....	27,800	26,991	9,346
207	Game Laws for 1904 .....	.....	7,756	2,224
208	Varieties of Fruits Recommended for Planting .....	66,366	55,466	10,900
209	Controlling the Boll Weevil in Cotton Seed and at Gin- neries .....	15,600	13,775	2,268
210	Experiment Station Work—XXVII .....	26,100	24,772	8,014
211	The Use of Paris Green in Controlling the Cotton Boll Weevil .....	20,600	14,430	2,529
212	The Cotton Bollworm .....	10,800	14,501	3,366
213	Raspberries .....	41,900	34,137	13,313
214	Beneficial Bacteria for Leguminous Crops .....	20,000	12,229	12,786
215	Alfalfa Growing .....	71,776	54,624	17,152
216	The Control of the Boll Weevil .....	11,000	15,629	3,717
217	Essential Steps in Securing an Early Crop of Cotton ..	41,000	40,312	3,167
218	The School Garden .....	41,000	50,996	13,815
219	Lessons from the Grain Rust Epidemic of 1904 .....	35,200	32,382	5,350
220	Tomatoes .....	116,400	104,822	17,578
221	Fungous Diseases of the Cranberry .....	.....	3,325	2,451
222	Experiment Station Work—XXVIII .....	48,000	36,447	11,553
223	Miscellaneous Cotton Insects in Texas .....	15,000	15,068	3,124
224	Canadian Field Peas .....	31,200	30,281	9,911
225	Experiment Station Work—XXIX .....	41,700	41,770	14,605
226	Relations of Coyotes to Stock Raising in the West ..	15,000	10,928	5,972
227	Experiment Station Work—XXX .....	50,400	34,001	16,399
228	Forest Planting and Farm Management .....	81,500	38,887	35,126
229	The Production of Good Seed Corn .....	132,400	101,335	31,065
230	Game Laws for 1905 .....	30,000	18,200	11,800
231	Spraying for Cucumber and Melon Diseases .....	46,200	29,711	16,489
232	Okra, Its Culture and Uses .....	30,000	12,249	10,465
233	Experiment Station Work—XXXI .....	45,600	31,228	14,372
234	The Guinea Fowl .....	35,600	12,700	18,416
235	Preparation of Cement .....	80,000	39,290	40,710
236	Incubation and Incubators .....	80,700	44,608	24,057
237	Experiment Station Work—XXXII .....	45,300	28,676	16,624
238	Citrus Fruit Growing in the Gulf States .....	29,800	10,562	6,759
239	The Corrosion of Fence Wire .....	36,000	16,770	16,922
240	Inoculation of Legumes .....	62,200	22,902	24,165
241	Butter Making on the Farm .....	61,400	48,398	13,002
242	An Example of Model Farming .....	70,000	52,161	17,839
243	Fungicides and their Use in Preventing Diseases of Fruit .....	30,900	14,630	16,270
244	Experiment Station Work—XXXIII .....	40,500	29,520	10,980
245	Renovation of Worn-out Soils .....	50,600	36,286	14,314
246	Saccharine Sorghums for Forage .....	30,000	12,690	5,885
247	The Control of the Codling Moth and Apple Scab .....	30,600	18,415	9,576
248	The Lawn .....	30,030	21,933	9,097
249	Cereal Breakfast Foods .....	30,400	24,269	6,131
250	The Prevention of Wheat Smuts and Loose Smuts of Oats.	25,000	17,091	7,909
251	Experiment Station Work—XXXIV .....	30,000	19,585	10,415
252	Maple Sugar and Sirup .....	30,000	7,847	5,853
253	The Germination of Seed Corn .....	40,200	33,271	6,929
254	Cucumbers .....	5,000	.....	.....
255	The Home Vegetable Garden .....	40,000	29,261	10,739
256	Preparation of Vegetables for the Table .....	20,000	15,868	4,132
257	Soil Fertility .....	10,000	5,900	4,100
258	Texas or Tick Fever and its Prevention .....	30,000	5,731	2,986
259	Experiment Station Work—XXXV .....	30,000	8,399	4,145
	Total .....	6,763,299	5,279,476	2,228,945

*Publications received and distributed by the Weather Bureau during the year ended June 30, 1906.*

Number and title of publication.	Number of copies.
QUARTER ENDED SEPTEMBER 30, 1905.	
<i>Received.</i>	
No. 332. Monthly Weather Review for May, 1905.....	5, 150
No. 333. Meteorological Charts of the Great Lakes, No. 1, 1905.....	2, 500
No. 334. Temperature and Relative Humidity Data—Bulletin O.....	1, 500
No. 335. Monthly Weather Review for June, 1905.....	5, 150
No. 336. Improved Methods for Finding Altitude and Azimuth, Geographical Position, and the Variation of the Compass (reprint from the Monthly Weather Review for June, 1905).....	3, 000
Washington Daily Weather Maps.....	148, 120
Weather-Crop Bulletins.....	60, 160
<i>Distributed.</i>	
No. 292. Climatology of California—Bulletin L.....	19
No. 294. Weather Folklore—Bulletin No. 33.....	145
No. 301. Climatic Charts.....	10
No. 303. Floods of the Mississippi, Spring of 1903—Bulletin M.....	13
No. 311. Climate—Bulletin No. 34.....	13
No. 312. Invariability of Our Winter Climate.....	8
No. 314. Circulation of the Atmosphere.....	7
No. 322. Long Range Weather Forecasts—Bulletin No. 35.....	597
No. 326. Periodic Variation of Rainfall in the Arid Region—Bulletin N.....	21
No. 327. Evaporation Observations in the United States.....	9
No. 332. Monthly Weather Review for May, 1905.....	5, 150
No. 333. Meteorological Charts of the Great Lakes, No. 1, 1905.....	2, 450
No. 334. Temperature and Relative Humidity Data—Bulletin O.....	5
No. 335. Monthly Weather Review for June, 1905.....	5, 150
No. 336. Improved Methods for Finding Altitude and Azimuth, etc.....	2, 000
Washington Daily Weather Maps.....	148, 120
Weather-Crop Bulletins.....	60, 160
Report of the Chief of the Weather Bureau, 1891-92.....	7
Report of the Chief of the Weather Bureau, 1892-93.....	8
Report of the Chief of the Weather Bureau, 1893-94.....	8
Report of the Chief of the Weather Bureau, 1894-95.....	9
Report of the Chief of the Weather Bureau, 1895-96.....	7
Report of the Chief of the Weather Bureau, 1896-97.....	7
Report of the Chief of the Weather Bureau, 1897-98.....	7
Report of the Chief of the Weather Bureau, 1898-99.....	7
Report of the Chief of the Weather Bureau, 1899-1900.....	7
Report of the Chief of the Weather Bureau, 1900-1901.....	7
Report of the Chief of the Weather Bureau, 1901-2.....	7
Report of the Chief of the Weather Bureau 1902-3.....	7
Report of the Chief of the Weather Bureau, 1903-4.....	948
Separates from Reports of the Chief of the Weather Bureau.....	7
Weather Bureau Bulletin No. 16.....	8
Weather Bureau Bulletin No. 22.....	8
Weather Bureau Bulletin No. 25.....	10
Weather Bureau Bulletin No. 26.....	35
Weather Bureau Bulletin No. 28.....	9
Weather Bureau Bulletin No. 30.....	20
Weather Bureau Bulletin No. 32.....	8
Weather Bureau Bulletin A.....	6
Weather Bureau Bulletin E.....	8
Weather Bureau Bulletin G.....	6
Weather Bureau Bulletin H.....	7
Weather Bureau Bulletin K.....	6

QUARTER ENDED DECEMBER 31, 1905.

<i>Received.</i>	
No. 337. Monthly Weather Review for July, 1905.....	5, 200
No. 338. Annual Report of the Chief of the Weather Bureau for 1905.....	5, 000
No. 339. Daily River Stages, 1900-1904.....	350
No. 340. Monthly Weather Review for August, 1905.....	5, 200
No. 341. Monthly Weather Review for September, 1905.....	5, 200
Washington Daily Weather Maps.....	152, 380
Weather-Crop Bulletins.....	14, 730
Snow and Ice Bulletins.....	7, 200

*Distributed.*

No. 292. Climate of California—Bulletin L.....	8
No. 294. Weather Folklore—Bulletin No. 33.....	98
No. 301. Climatic Charts.....	14
No. 303. Floods of the Mississippi, Spring of 1903—Bulletin M.....	50
No. 311. Climate—Bulletin No. 34.....	14
No. 312. Invariability of Our Winter Climate.....	5



*Publications received and distributed by the Weather Bureau during the year ended June 30, 1906—Continued.*

Number and title of publication.	Number of copies.
QUARTER ENDED DECEMBER 31, 1905—continued.	
<i>Distributed—Continued.</i>	
No. 322. Long Range Weather Forecasts—Bulletin No. 35 .....	170
No. 326. Periodic Variation of Rainfall in the Arid Regions—Bulletin N .....	40
No. 327. Evaporation Observations in the United States .....	215
No. 333. Meteorological Charts of the Great Lakes, No. 1, 1905 .....	20
No. 334. Temperature and Relative Humidity Data—Bulletin O .....	314
No. 336. Improved Methods for Finding Altitude, Azimuth, etc .....	420
No. 337. Monthly Weather Review for July, 1905 .....	5,200
No. 338. Annual Report of the Chief of the Weather Bureau for 1905 .....	1,800
No. 340. Monthly Weather Review for August, 1905 .....	5,200
No. 341. Monthly Weather Review for September, 1905 .....	5,200
Washington Daily Weather Maps .....	152,380
Weather-Crop Bulletins .....	14,730
Snow and Ice Bulletins .....	7,200
Cloud Forms .....	58
Report of the Chief of the Weather Bureau, 1896-97 .....	1
Report of the Chief of the Weather Bureau, 1901-2 .....	2
Report of the Chief of the Weather Bureau, 1903-4 .....	18
Weather Bureau Bulletin No. 22 .....	4
Weather Bureau Bulletin No. 25 .....	3
Weather Bureau Bulletin No. 26 .....	18
Weather Bureau Bulletin No. 30 .....	15
Weather Bureau Bulletin No. 32 .....	5
Lettered Bulletins "E," "G," "H," and "K," each .....	1
Weather Bureau Bulletin No. 25 .....	9
Weather Bureau Bulletin No. 26 .....	36
Weather Bureau Bulletin No. 28 .....	4
Weather Bureau Bulletin No. 30 .....	34
Weather Bureau Bulletin No. 32 .....	6
Weather Bureau Bulletin E .....	5
Weather Bureau Bulletin G .....	5
Weather Bureau Bulletin H .....	13
Weather Bureau Bulletin K .....	7
QUARTER ENDED MARCH 31, 1906.	
<i>Received.</i>	
No. 342. Relations Between Climates and Crops—Bulletin No. 36 .....	1,000
No. 343. Monthly Weather Review for October, 1905 .....	5,200
No. 344. Studies on Diurnal Periods of Lower Atmosphere (reprint) .....	1,500
No. 345. Monthly Weather Review for November, 1905 .....	5,200
No. 346. Monthly Weather Review for December, 1905 .....	5,250
No. 347. Instructions for Cooperative Observers .....	10,000
No. 348. Annual Summary of Monthly Weather Review for 1905 .....	5,250
No. 349. Recent Practice in Erection of Lightning Conductors—Bulletin No. 37 .....	1,000
No. 350. Meteorological Charts of the Great Lakes, No. 2, 1905 .....	2,500
No. 351. Monthly Weather Review for January, 1906 .....	5,250
Washington Daily Weather Maps .....	154,190
National Weather Bulletins .....	15,350
Snow and Ice Bulletins .....	23,790
<i>Distributed.</i>	
No. 292. Climate of California—Bulletin L .....	18
No. 294. Weather Folklore—Bulletin No. 33 .....	77
No. 301. Climatic Charts .....	8
No. 303. Floods of the Mississippi Valley, spring of 1903—Bulletin M .....	35
No. 311. Climate—Bulletin No. 34 .....	12
No. 312. Invariability of Our Winter Climate .....	9
No. 322. Long Range Weather Forecasts—Bulletin No. 35 .....	103
No. 326. Periodic Variation of Rainfall in Arid Regions—Bulletin N .....	81
No. 327. Evaporation Observations in the United States .....	14
No. 334. Temperature and Relative Humidity Data—Bulletin O .....	42
No. 336. Improved Methods of Finding Altitude, Azimuth, etc .....	28
No. 338. Annual Report of Chief of Weather Bureau, 1905 .....	1,583
No. 339. Daily River Stages, Part VII .....	476
No. 342. Relations Between Climates and Crops—Bulletin No. 36 .....	633
No. 343. Monthly Weather Review for October, 1905 .....	5,200
No. 345. Monthly Weather Review for November, 1905 .....	5,200
No. 346. Monthly Weather Review for December, 1905 .....	5,250
No. 347. Instructions for Cooperative Observers .....	4,800
No. 348. Annual Summary of Monthly Weather Review for 1905 .....	5,250
No. 349. Recent Practice in Erection of Lightning Conductors—Bulletin No. 37 .....	481
No. 350. Meteorological Charts of the Great Lakes, No. 2, 1905 .....	2,500
No. 351. Monthly Weather Review for January, 1906 .....	5,250
Washington Daily Weather Maps .....	154,190
National Weather Bulletins .....	15,350

*Publications received and distributed by the Weather Bureau during the year ended June 30, 1906—Continued.*

Number and title of publication.	Number of copies.
QUARTER ENDED MARCH 31, 1906—continued.	
<i>Distributed—Continued.</i>	
Snow and Ice Bulletins .....	23, 790
Cloud Forms .....	50
Annual Report of the Chief of the Weather Bureau, 1896-97 .....	2
Annual Report of the Chief of the Weather Bureau, 1897-98 .....	4
Annual Report of the Chief of the Weather Bureau, 1898-99 .....	5
Annual Report of the Chief of the Weather Bureau, 1899-1900 .....	3
Annual Report of the Chief of the Weather Bureau, 1900-1901 .....	5
Annual Report of the Chief of the Weather Bureau, 1901-2 .....	4
Annual Report of the Chief of the Weather Bureau, 1902-3 .....	11
Annual Report of the Chief of the Weather Bureau, 1903-4 .....	14
Weather Bureau Bulletin No. 25 .....	5
Weather Bureau Bulletin No. 26 .....	35
Weather Bureau Bulletin No. 28 .....	5
Weather Bureau Bulletin No. 30 .....	22
Weather Bureau Bulletin No. 32 .....	7
Weather Bureau Bulletin E. ....	5
Weather Bureau Bulletin G. ....	3
Weather Bureau Bulletin H. ....	11
Weather Bureau Bulletin K. ....	3
QUARTER ENDED JUNE 30, 1906.	
<i>Received.</i>	
No. 311. Climate—Bulletin No. 34 (reprint) .....	2, 000
No. 352. Monthly Weather Review for February, 1906 .....	5, 250
No. 353. Monthly Weather Review for March, 1906 .....	5, 250
No. 354. Monthly Weather Review for April, 1906 .....	5, 250
No. 356. Meteorological Charts of the Great Lakes, No. 1, 1906 .....	2, 500
No. 357. Monthly Weather Review for May, 1906 .....	5, 250
Washington Daily Weather Map .....	158, 830
National Weather Bulletin .....	58, 720
Annual Report of the Chief of the Weather Bureau, 1904-5 .....	1, 000
<i>Distributed.</i>	
No. 292. Climate of California—Bulletin L. ....	13
No. 294. Weather Folklore—Bulletin No. 33 .....	25
No. 301. Climatic Charts .....	11
No. 303. Floods of the Mississippi Valley, Spring of 1903—Bulletin M. ....	6
No. 311. Climate—Bulletin No. 34 .....	20
No. 312. Invariability of Our Winter Climate .....	4
No. 322. Long Range Weather Forecasts—Bulletin No. 35 .....	27
No. 326. Periodic Variation of Rainfall in the Arid Region—Bulletin N. ....	34
No. 327. Evaporation Observations in the United States .....	12
No. 354. Temperature and Relative Humidity Data—Bulletin O. ....	27
No. 356. Improved Methods of Finding Altitude, etc. ....	10
No. 358. Annual Report of the Chief of the Weather Bureau, 1905 .....	250
No. 359. Daily River Stages, Part VII .....	4
No. 342. Relations Between Climates and Crops—Bulletin No. 36 .....	106
No. 344. Studies on Diurnal Periods, etc. (reprint) .....	1, 275
No. 349. Recent Practice in Erection of Lightning Conductors—Bulletin No. 37 .....	650
No. 352. Monthly Weather Review for February, 1906 .....	5, 250
No. 353. Monthly Weather Review for March, 1906 .....	5, 250
No. 354. Monthly Weather Review for April, 1906 .....	5, 250
No. 357. Monthly Weather Review for May, 1906 .....	5, 250
Washington Daily Weather Maps .....	158, 830
National Weather Bulletins .....	58, 720
Annual Report of the Chief of the Weather Bureau, 1891-92 .....	;
Annual Report of the Chief of the Weather Bureau, 1893 .....	5
Annual Report of the Chief of the Weather Bureau, 1894 .....	5
Annual Report of the Chief of the Weather Bureau, 1895 .....	6
Annual Report of the Chief of the Weather Bureau, 1896-97 .....	11
Annual Report of the Chief of the Weather Bureau, 1897-98 .....	6
Annual Report of the Chief of the Weather Bureau, 1898-99 .....	6
Annual Report of the Chief of the Weather Bureau, 1899-1900 .....	7
Annual Report of the Chief of the Weather Bureau, 1900-1901 .....	5
Annual Report of the Chief of the Weather Bureau, 1901-2 .....	7
Annual Report of the Chief of the Weather Bureau, 1902-3 .....	6
Annual Report of the Chief of the Weather Bureau, 1903-4 .....	13
Annual Report of the Chief of the Weather Bureau, 1904-5 .....	25

## REPORT OF THE CHIEF OF THE BUREAU OF STATISTICS

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF STATISTICS,  
*Washington, D. C., September 30, 1906.*

SIR: I have the honor to submit herewith a report of the work of the Bureau of Statistics for the fiscal year ended June 30, 1906.

Respectfully,

VICTOR H. OLMSTED,  
*Chief of Bureau.*

Hon. JAMES WILSON,  
*Secretary.*

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### ORGANIZATION.

The Bureau of Statistics of the Department of Agriculture consists of three divisions—the Division of Domestic Crop Reports, the Division of Foreign Markets, and the Miscellaneous Division. At the beginning of the last fiscal year the Chief of the Bureau was assisted in his work by an associate statistician and an assistant statistician. Upon the appointment of the present Chief of the Bureau, June 16, 1906, the office of associate statistician was abolished, so that at present the officials of the Bureau are the Statistician and Chief of Bureau, the assistant statistician, chief clerk, chief of the Division of Domestic Crop Reports, and the chief of the Division of Foreign Markets. No chief to the Miscellaneous Division has as yet been appointed, it being under the direct supervision of the assistant statistician.

### WORK OF THE YEAR.

#### DIVISION OF DOMESTIC CROP REPORTS.

One of the most important branches of the statistical work of the Bureau is performed in the Division of Domestic Crop Reports. Practically three-fourths of the annual appropriation for the Bureau is expended in the collection and compilation of data, a large proportion of which this division handles. Through it and through the special field and State agents of the Bureau continuous inquiry is made regarding agricultural areas, conditions, and yields, as far as the principal products of the soil are concerned, while many minor crops are dealt with from month to month throughout the year. The number and value of farm animals and the loss of such animals annually resulting from disease and exposure are also reported upon, and the information from month to month regarding crops and farm animals is placed in comparison with similar information at corresponding dates in preceding years.



Cotton is reported upon seven times, wheat eight times, corn and oats each six times, and barley, rye, buckwheat, hay and grass, potatoes, tobacco, fruit, rice, and 40 other minor products from two to eight times in each year.

During the year plans were formulated and carried into effect for securing information enabling the making of monthly reports upon 25 crops not previously dealt with by the Bureau. This addition has largely increased the work of both the field and the office force and has taxed the working capacity of the employees of the Bureau. Altogether, there are now 53 different crops dealt with each year, regarding which 333 inquiries are made between January and December, in addition to 8 classes of domestic live stock, concerning which 39 inquiries are made in the course of the year.

The figures resulting from these investigations are published in the Crop Reporter, which is issued monthly. Upward of 1,300,000 copies of this publication were issued during the year. Bulletins are printed on cards giving the principal features of the reports each month, and these are posted in post-offices throughout the entire United States for the information of farmers. The principal results of the investigations made during the year are published annually in the Yearbook, together with statistical tables of prices, etc., of agricultural products, and much other statistical data germane to agricultural interests.

The tobacco crop is reported upon according to its differentiated commercial types, as well as by the political divisions of its area of production, the method having met with favor among all classes interested in this product. An expert is specially employed in this work.

#### SOURCES OF INFORMATION.

In addition to the information derived through reports of special field agents and State statistical agents, the Bureau has lists of correspondents of various classes, each reporting independently of the others, numbering in the aggregate about 150,000. Prior to last year the number listed was much larger than stated, but during the year the lists have been revised and many thousand names of negligent, deceased, or "moved" correspondents have been eliminated, while the names of several thousand new active correspondents have been added.

The number of reports received from these correspondents, all of which are tabulated and computed in the Division of Domestic Crop Reports, is as great as it is possible for the Bureau to handle from month to month with its present clerical force.

There are altogether six different classes of correspondents in addition to the special field agents and the State statistical agents. The returns of each of the classes are tabulated and computed independently, and the results for the different States are utilized by the crop-reporting board in making their final estimates each month.

#### SPECIAL FIELD SERVICE.

The special field service is composed of traveling field agents, each assigned to report from month to month on all crops dealt with by the Bureau, for a group of States, or to the investigations of special subjects, as tobacco or rice, the importance of which require particular attention. Their duty is to travel continuously throughout the territory assigned, securing information through observation and by consulting

with farmers, merchants, agricultural-implement dealers, country bankers, and others capable of giving reliable information. They are required to examine the growing crops in the fields, and each of them has a list of correspondents who report to him from month to month. This service has been greatly strengthened during the year, and comprehensive instructions have been given the field agents from time to time regarding methods to be pursued and assigning specific work and territory. The number of agents has been increased to 15. The principal cotton-producing States are now covered by 5 special field agents; 7 others are assigned to the remaining territory in the United States, including the principal wheat and corn producing States; 2 are engaged in collecting statistics regarding the tobacco and rice crops, and 1 is employed in the collection of statistical data regarding agricultural education in rural schools.

#### STATE STATISTICAL AGENTS.

At the end of the fiscal year State statistical agents were located in 45 States. All of them are men of high standing and repute. Each of them reports for his State as a unit and maintains a corps of correspondents throughout the different sections of his State entirely independent of those reporting direct to the Bureau at Washington. These correspondents number in the aggregate about 12,000.

Special efforts have been made during the year to improve and perfect this important service, and careful instructions have been issued and complied with regarding the location of the correspondents of the State agents in every part of their respective States, who are required to be so distributed geographically as to cover adequately each State. Instructions have also been issued and put into force regarding the tabulations and computations of the reports received by the different State agents from their correspondents. The methods now in use are scientific, uniform, and satisfactory. The various State agents have all been visited and inspected by officials of the Bureau during the year, and it is gratifying to note that highly satisfactory results have been attained by bringing the officials in personal contact with these agents, investigating their methods, ascertaining how they select their correspondents, and looking into their proper geographical distribution and giving them personal instructions in the conduct of their work.

It is intended to increase the efficacy and reliability of this important class of agents by authorizing them to travel within and throughout their respective States two or three times a year for the purpose of making personal investigations of crop conditions and of coming in contact with their correspondents and enlisting the services of new ones. One of these trips will be in the spring at the time inquiries are made as to the acreage of the principal crops, and another in the fall at or near the time of harvest, when important data as to the yield and production are required. Another journey will be authorized in such States and at such times as agricultural exigencies require.

#### THE PREPARATION OF MONTHLY CROP REPORTS.

Under the administration of Hon. W. M. Hays, Assistant Secretary of Agriculture (who was placed in charge of the Bureau upon the resignation of the former Statistician, Mr. John Hyde, July 18, 1905,

and remained in charge until June 16, 1906, when the present Statistician was appointed), an improved and satisfactory method of preparing the monthly crop reports was inaugurated by placing the final responsibility therefor in a crop-reporting board, thus securing the benefit of consultation and a consensus of judgment, and reducing the possibility of error to a minimum. The crop-reporting board is composed of the chief of the Bureau as chairman and four other members whose services are brought into requisition each crop-reporting day from among the statisticians and officials of the Bureau, and the special field and State statistical agents who are called to Washington for the purpose.

The personnel of the board is usually changed each month. The meetings are held in the office of the Chief of the Bureau, which is kept locked during its sessions, no one being allowed to enter or leave the room, and all telephones being disconnected.

When the board has assembled reports and telegrams regarding speculative crops from State and field agents, which have been placed unopened in a safe in the office of the Secretary of Agriculture, are opened and tabulated, and the reports, by States, from the several classes of correspondents and agents relating to all crops dealt with are brought together in convenient parallel columns on final tabulation slips; the board is thus provided with several separate estimates covering each State and each separate crop, made independently by the respective classes of correspondents and agents of the Bureau, each reporting for a territory or geographical unit with which he is thoroughly familiar.

Abstracts of the weather-condition reports in relation to the different crops, by States, are also prepared from the weekly bulletins of the Weather Bureau. With all these data before the board, each individual member computes independently, on a separate sheet, his own estimate of the acreage, condition, or yield of each crop, or of the number, condition, etc., of farm animals for each State separately. These results are then compared and discussed by the board under the supervision of the chairman, and the final figures for each State are decided upon. It has been interesting to note how often the reports of the different classes of correspondents and agents are very nearly identical, and how closely the figures arrived at independently by the individual members of the board agree. The estimates by States as finally determined by the board are weighted by the acreage figures for the respective States, the result for the United States being a true weighted average for each subject.

There have been 17 meetings of the crop-reporting board during the past year, in most of which the personnel has been changed each month. Six special field agents, specialists in their several lines of statistical and crop knowledge, and 12 State statistical agents have served in the different board meetings. Many of these men are widely known throughout the United States, and the practice of having them take part in the preparation of the monthly reports and estimates has proved highly satisfactory, and has been a great factor in establishing the confidence of the public generally throughout the country in the fairness and correctness of the Bureau's estimates.

At the beginning of the year no regular orders or formal instructions had been prepared as to the preparation of reports; therefore, in order to safeguard, expedite, and make secure the compilations and



computations in connection with their preparation, detailed and comprehensive orders were promulgated in relation thereto on July 8, 1905, as follows:

[United States Department of Agriculture, Office of the Secretary, Washington, D. C.]

ORDERS GOVERNING THE PREPARATION OF MONTHLY CROP REPORTS OF THE BUREAU OF STATISTICS.

It is hereby ordered that the following methods be used hereafter in the Bureau of Statistics of this Department in the handling, compilation, and preparation of monthly crop reports:

First. The following classes of correspondents send their reports to the Bureau of Statistics for tabulation:

- County correspondents.
- Township correspondents.
- Individual farmers.
- Cotton ginner.
- Special cotton correspondents.

The schedules sent in by the above-named correspondents are tabulated in the Division of Domestic Crop Reports of the Bureau of Statistics.

In order to prevent the possibility of collusion among any of the clerks engaged in this tabulation, or of any individual clerk drawing deductions from the results shown for any State or States tabulated by him (which they, or he, might be tempted to disclose improperly), the following method must be employed in dealing with States of relatively large production:

(a) After the schedules have been tabulated on the sheets for the respective States the figures thereon shall be added for each crop represented, so as to show a total for only a portion of the State, omitting a group of counties at the bottom of the sheet. As rapidly as such partial totals are made the sheets must be handed to the Chief of the Division.

(b) The Chief of the Division will then number the tabulation sheets at the top (where the names of the States to which they relate are written) and at the foot (where there is nothing to indicate the States to which they relate), using the same number at both the top and the foot of each sheet. He will then place these numbers on a separate sheet, kept on his desk, without making any memorandum to show the States to which they pertain, but for the purpose of avoiding the use of the same number on sheets relating to different States.

(c) The Chief of the Division will then, personally, cut the tabulation sheets in two parts, so that the partial total will be at the top of the lower part and so that *no names of counties* will appear thereon.

(d) He will immediately deliver the upper part, upon which the name of the State is written, to the Statistician.

(e) The Chief of the Division will then issue the lower parts of the tabulation sheets to clerks in other rooms from those in which they were tabulated and partially added, who will make the final additions and compute the averages thereon. As rapidly as they are completed by the clerks, the Chief of the Division will deliver them to the Statistician, who will be able to assign the figures to their proper States by means of the numbers placed on the top and on the bottom of the sheets before they were cut in two.

(f) The tabulation of county and township correspondents' schedules relating to cotton in Texas and Georgia shall be delivered by the Chief of the Division, as soon as completed, to the Secretary or Assistant Secretary of Agriculture (instead of to the Statistician), who will keep said sheets in a locked receptacle until the morning of the day on which the cotton report is issued, when they will be delivered to the Statistician by the Secretary or Assistant Secretary.

Second. The reports of State statistical agents are handled only by the Statistician and his assistant.

In order to prevent access to such of these reports as relate to speculative crops by any person connected with the Bureau of Statistics prior to the day on which the Bureau's report to which they relate is issued, or the possibility of premature information being derived from them, they will be addressed to the Secretary of Agriculture, the address to be written with red ink and the letter "A" to be plainly marked on the ends of the envelopes in which they are transmitted. The letters thus addressed will be delivered by the postal authorities to the Secretary of Agriculture or Assistant Secretary, in sealed mail pouches. These pouches will be opened only by

the Secretary or Assistant Secretary, who will place their contents in a safe, with seals unbroken, where they will remain, sealed, until the time arrives for their use in preparing the crop estimates.

(a) *In regard to cotton.*—These reports of the State statistical agents shall not be removed from the safe and their seals broken until the morning of the day on which the report on cotton is issued, when they will be delivered to the Statistician by the Secretary or Assistant Secretary.

(b) *In regard to other crops* (reports upon several of which are made each month by the State statistical agents).—Agents shall be instructed to inclose their reports relating to what are known as "speculative crops" (such as wheat, corn, or oats) in separate envelopes from their reports on other (nonspeculative) crops, plainly marking the first envelopes "A" and the others "B."

The envelopes marked "A" (containing reports on speculative crops) shall be placed, with their seals unbroken, in the safe, and there remain until the morning of the day on which the report of the Bureau is issued, when they will be delivered by the Secretary or Assistant Secretary to the Statistician. The envelopes marked "B" (containing reports on nonspeculative crops) which will be addressed to the Bureau of Statistics, can be opened when received and the data they contain used by the Statistician in computing estimates regarding the crops to which they relate in advance of the day on which the Bureau's report is issued.

(c) The combination for opening the safe in which the above documents are kept shall be known only to the Secretary and Assistant Secretary of Agriculture.

Third. Reports of special field agents may be made and handled in the same manner as those of State statistical agents.

Fourth. On the day on which the report of the Bureau is issued, the Statistician's room, in which he establishes his final figures, must be kept locked, and no one not engaged in assisting him permitted to enter; also, those in the room must remain there until the report is issued, unless permitted to leave, temporarily, by the Secretary of Agriculture.

(a) No one shall be allowed in said room on the day on which the report of the Bureau is issued except the Statistician, his assistant, his stenographer, and the Secretary or Assistant Secretary of Agriculture without permission of the Secretary of Agriculture.

(b) The final computations of the United States, relating to cotton and speculative crops, based on the figures determined by the Statistician for the different States, shall be made by clerks locked in the room adjoining and opening into the Statistician's room, who shall not be permitted to leave said room until the issuance of the Bureau's report, without permission of the Secretary of Agriculture.

(c) The final computations for the United States relating to nonspeculative crops may be made by clerks under the direction of the Chief of the Division of Domestic Crop Reports.

Fifth. The telegraphic reports of State statistical agents and of special field agents regarding cotton and other speculative crops must be addressed to the Secretary of Agriculture; those relating to nonspeculative crops should be addressed to "Olmsted."

(a) Telegraphic reports addressed to the Secretary of Agriculture shall be placed in the safe unopened and there remain until the morning of the day on which the Bureau's report is issued, when they will be delivered to the Statistician.

(b) Telegraphic reports addressed to "Olmsted" may be used as received by the Statistician prior to the date of the issuance of the report.

Sixth. *Care of records.*—The tabulation sheets and the sheets containing the preliminary and final computations of the Statistician and his assistant relating to each monthly crop report, together with all letters and reports from State statistical agents, special field agents, or anyone else relating thereto, shall be filed in a library case, used exclusively for that special purpose, and kept locked therein, except when needed for use by the Statistician or his assistant.

(a) These records shall be so kept in the library case that all tabulation sheets, reports, letters, and computation sheets, relating to any month, shall be together and shall be wholly separated from those relating to any other month.

(b) The records shall not be accessible to any person other than the Statistician and his assistant without an order from the Secretary or Assistant Secretary, except that tabulation sheets for a preceding year may be used by the chief of the Division of Domestic Crop Reports for the purpose of copying the column headings and county weights when preparing blank tabulation sheets for future use.

Seventh. All telephones in the Bureau of Statistics must be disconnected before 9 a. m. of the day on which the Bureau's report is issued, and so remain until after its issuance.

JAMES WILSON,  
*Secretary of Agriculture.*

## DIVISION OF FOREIGN MARKETS.

While devoting the usual attention to the exports of farm products, the Division of Foreign Markets has made an investigation as to the subject of the exports of packing-house products and meat products, not only from this country, but also from the principal competing countries in the markets of the world.

In the pursuit of this work it was necessary to make a complete and technically accurate translation of the tariffs of the fourteen nations which import almost the entire exports of these commodities from nations having a surplus, these importing countries being the United Kingdom, Germany, the Netherlands, Belgium, Cuba, Sweden, Norway, France, Denmark, Italy, Austria-Hungary, Russia, Spain, and Switzerland.

## CONDITIONS IN COMPETING COUNTRIES.

In connection with this subject the general policy of investigating conditions in countries competing with the United States in the world's markets was followed with regard to packing-house products and meat animals, and a large amount of instructive matter has been collected and published.

Still another division of this work was an exhaustive compilation of statistics of exports from the United States for a period of fifteen years, in which the countries to which the goods were consigned were shown. A thorough examination of imports by the 14 principal countries, a list of which is given in connection with a statement concerning tariff translations, was made, the official reports of these countries being the basis.

## WORLD'S MEAT TRADE.

The investigations of the Division of Foreign Markets disclosed that the world's meat trade in 1904 amounted to about half a billion dollars in value. This total was made up of \$124,000,000 for live meat animals, \$354,000,000 for packing-house products, and \$29,000,000 for poultry, game, etc. The percentage of the meat imports of the world derived from the United States was 40.4, for live meat animals, 34.2, and for packing-house products, 45.3, France and Denmark being excepted from these three computations. The percentage for poultry, game, etc., was 4.3, omitting France, Belgium, Denmark, and Norway.

## ANIMAL DISEASES.

Another subject of timely study was on comparative healthfulness of meat animals. Germany was taken for comparison with the United States because that is the only country from which statistics of meat inspection can be obtained. Statistics for 16 principal German cities were compared with the results obtained under the regulations of this Department in the inspection of meat intended for export from this country, the latest comparable statistics being for the fiscal years 1901, 1902, and 1903. Among the diseases for which they are partially or totally condemned tuberculosis is in the lead, the percentage for beef cattle in the 16 German cities being, respectively, 18.9, 19.9, and 23.7 for the years mentioned, as comparing with 0.12, 0.14, and 0.14 in the United States. The statistics of both countries show that



of the different meat animals sheep enjoy the greatest freedom from disease, while horses and beef cattle, in the order named, exhibit the highest percentage of total condemnations.

#### COTTON.

The situation throughout the world with regard to cotton production has continued to be a subject of investigation, and it is still impossible to find any tangible evidence of the prospective production of cotton in any country which will be a serious competitor of the Upland cotton of this country.

#### DAIRY PRODUCTS IN THE BRITISH MARKETS.

The British market for dairy products and its sources of supply have been studied with more than ordinary thoroughness and a large amount of information has been collected which will soon be published.

#### WHEAT GROWING IN RUSSIA.

Notwithstanding the very rapid increase of consumption of wheat in our domestic markets, the United States still remains one of the chief exporters of wheat and flour; in this trade Russia is our main competitor in the European markets. During the last few years Russia has even gained the upper hand as far as the quantity of exports of wheat is concerned. This subject has been investigated and the results embodied in a special report.

#### FREIGHT RATES.

Studies have been made of ocean freight rates on wheat, cotton, and other commodities and of railroad freight rates on grain to the seaboard.

#### WORLD'S PRODUCTION.

During the last year tables have been made showing the world's production of barley, rye, potatoes, tobacco, hops, sugar, flax, rice, cotton, and wool, and for the principal classes of live stock for most of the countries of the world at the latest date for which the figures were ascertainable. These figures are published in the Yearbook for 1905.

#### WORLD'S TRADE.

It is desirable to know the amount of products that remains above home consumption to enter the world's trade; therefore this Division has compiled the world's trade in wheat, cotton, tobacco, rice, sugar, and wool, and, as before mentioned, packing-house products and meat animals. The results of this compilation may be found in the Yearbook for 1905. In addition, the world's trade in corn, coffee, tea, hops, butter, cheese, oil cake and oil-cake meal, cotton-seed oil, flaxseed, india rubber, and turpentine is now being compiled from original sources of information.

#### INCREASE IN FARM VALUES.

Such has been the increase in farm prices of farm products and so well known has become the larger measure of prosperity that has come to farmers, that this Bureau undertook in the autumn of 1905 to dis-

cover the degree of increase in farm real estate in all parts of the country. The effort was made to connect this investigation by statistical methods with the census valuation for 1900. Reports were received from 45,000 correspondents, representing substantially all the agricultural neighborhoods in the United States, and the results obtained from the tabulation of these reports indicated an increase of farm real-estate values during five years of 33.5 per cent, or an amount approximately equal to \$6,133,000,000. This investigation was made under the supervision of the Chief of the Division of Foreign Markets.

During the year the following bulletins, compiled in the Division of Foreign Markets, were completed and placed in the hands of the printer:

## PUBLICATIONS.

- No. 35. Imports of Farm and Forest Products, 1902-1904.
- No. 36. Exports of Farm and Forest Products, 1902-1904.
- No. 37. Trade with Noncontiguous Possessions in Farm and Forest Products, 1902-1904.
- No. 38. Crop Export Movement and Port Facilities on Atlantic and Gulf Coasts.
- No. 39. Meat in Foreign Markets, Tariffs of Fourteen Importing Nations, and Countries of Surplus.
- No. 40. Meat Animals and Packing-House Products Imported into Eleven Principal Countries, 1895-1904.
- No. 41. Norway, Sweden, and Russia as Markets for Packing-House Products.
- No. 42. Russia's Wheat Surplus.
- No. 43. Changes in Farm Values, 1900-1905.
- No. 44. Local Conditions as Affecting Farm Values, 1900-1905.
- No. 45. Imports of Farm and Forest Products, 1903-1905.
- No. 46. Exports of Farm and Forest Products, 1903-1905.
- No. 47. Trade with Noncontiguous Possessions in Farm and Forest Products, 1903-1905.

## MISCELLANEOUS DIVISION.

The Miscellaneous Division embraces the statistical library, the translators of the Bureau, and a few clerks engaged in special work, such as the compilation and preparation of material to be used in answering inquiries made by Members of Congress and others for agricultural statistics. The services of the clerks in this division are called into requisition in the tabulation and computation of the monthly crop reports or for any other purpose for which they may be required.

## EUROPEAN CROP CONDITIONS.

An employee of the Bureau is stationed in London and from that point makes journeys to the different European countries collecting information regarding crop acreages, conditions, and yields, which he sends to Washington each month for publication in the Crop Reporter. This agent also conducts special investigations for other Bureaus of the Department upon various subjects, such as the handling of fruits, freight rates, etc. The information supplied by him has been of great interest and value to producers and shippers from America.

## STATISTICAL LIBRARY.

Efforts have been continued to enlarge and perfect the statistical library, which is an integral part of the general library of the Department, but is segregated for the convenience of this Bureau. It is of

large magnitude now, and special efforts are being made to make it more complete as regards the agricultural statistics of the world. It consists of about 9,000 books and 3,000 monographs and pamphlets, all of which represent the official reports of the leading agricultural and commercial organizations of the United States and foreign countries and the principal boards of trade, chambers of commerce, bureaus of labor, etc.

The more important agricultural and statistical periodicals in this and foreign countries are secured by subscription or exchange and are carefully indexed. The index now contains over 44,000 cards and covers a wide range and a great variety of subjects. With this index as a basis, a large amount of reference library work has been done during the year. Many visitors have consulted these files and indexes, representing not only nearly all the Bureaus of this Department, but many other branches of the Government service.

A strong feature of the library is its collection of publications and reports, daily market reports, and price sheets, in which are given the prices of agricultural products and live stock as quoted in the leading commercial centers of the United States and foreign countries.

#### STATISTICAL WORK FOR OTHER BUREAUS.

There has been ready and harmonious cooperation between this and the other Bureaus, Divisions, and Offices of the Department during the year. The statistical work required by many of these other offices incident to their investigations and publications is largely done by the expert computers and compilers in this Bureau, and such statistical work as is not prepared here is often carefully revised and approved by the Statistician before publication by the other bureaus. During the fiscal year the cost of the statistical work which this Bureau performed for other bureaus has been about \$14,000, or 7 per cent of the total amount appropriated for the Bureau of Statistics.

#### COST OF PRODUCING FARM PRODUCTS.

From information gathered through investigations conducted through a series of years, bulletins were prepared and will be soon published regarding the cost of producing various farm products, which, it is believed, will be of great value and interest.

#### FILING SYSTEMS AND INDEXES.

Marked improvement has been made in the filing of the reports of the different classes of correspondents of the Bureau and the data upon which each monthly crop report is based. Large file cases have been provided so as to assemble all of these different reports for each month in one compartment, so that they can be readily referred to. The system of filing and indexing correspondence has also been entirely changed, the vertical filing system having been installed. In connection with this a subject index has been started, which is becoming an interesting and valuable bibliography of statistics of the different agricultural products.



**RECOMMENDATIONS.**

## CONFERENCE OF STATE STATISTICAL AGENTS.

By reason of the noticeable benefits to be derived from the traveling of State statistical agents, as shown by experiments already made, it is suggested that an increase in the appropriation of about \$10,000 can be most profitably provided for that purpose in connection with the strengthening of the special field service. This will enable the State agents to travel over their States at least twice each year and to come to Washington, D. C., for conference once during the year. During the fifteen years in which State statistical agents have been employed they have never been brought together, and it is submitted that a convention of these employees held here at the Department would be productive of marked benefits and improvement in this branch of the service.

## METAL HOLDERS FOR POSTMASTERS CARDS.

It is recommended that Congress make a provision of from \$3,000 to \$5,000 in next year's appropriation to pay the cost of metal holders in which crop cards sent to postmasters can be placed when they are received at the post-offices throughout the country each month. These cards are sent broadcast over the country for quick dissemination of reports throughout the farming districts. They contain a résumé of the monthly crop reports, and it is desired that these metal holders be provided so that they can be conveniently placed on the wall of each post-office, as are the Weather Bureau reports of the Department.

**COMMENT.**

For the past several months the Bureau and its reports have been singularly free from criticism and unfavorable comment; and it is gratifying to note that the special efforts which have been put forth to strengthen the crop-reporting service is being appreciated by the country at large.

There has been hearty and cordial cooperation between this Bureau and other offices of the Government, particularly with the Bureau of the Census, all of whom recognize that the services they render are deemed of great value to producers, consumers, and dealers in agricultural products, and who fully realize the importance of frankness, promptness, and accuracy in the publication of agricultural reports.



## REPORT OF THE LIBRARIAN.

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE LIBRARIAN,  
*Washington, D. C., September 1, 1906.*

SIR: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1906.

Respectfully,

JOSEPHINE A. CLARK, *Librarian.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### ADDITIONS TO THE LIBRARY.

The recorded number of books and pamphlets in the Library at the end of the fiscal year 1905 was, in round numbers, 87,000, which number has been increased during the fiscal year 1906 to 92,000. The number of books and pamphlets added to the Library during the past fiscal year was 5,000, an increase of 1,000 over that of the previous year. This increase was due chiefly to the greater number of books and pamphlets received by gift and in exchange for publications of the Department. Although a large number of Department publications are annually sent to institutions and individuals in the United States and abroad, the value of the exchanges received, especially from foreign sources, fully compensates the Department for the cost and the forwarding of its documents.

#### CATALOGUING.

During the past year all current accessions to the Library have been catalogued. The number of new cards added to the main catalogue was 19,483, including those prepared in the Library and those purchased from the Library of Congress, the Publishing Board of the American Library Association, and the Torrey Botanical Club. The main catalogue now contains, approximately, 160,000 cards. The printed cards obtained from the Library of Congress include those prepared and printed by the Library of Congress and those prepared by this Library, but printed and distributed by the Library of Congress. In thus cooperating with the Library of Congress there is not only a saving of time, labor, and money to this Library, but at the same time an



opportunity is afforded libraries throughout the country to procure many cards that are needed by them, and at less expense than the cards could be prepared by each library.

In addition to the main catalogue, composed of author, subject, and title cards, the Library maintains a shelf list numbering 38,273 cards, which serves the double purpose of a subject catalogue and a systematic index to the books as arranged on the shelves, and which is used in taking an inventory of the Library.

#### PERIODICALS.

The number of different technical periodicals and serials currently received in the Library during the past fiscal year has been 1,652, exclusive of annual reports of societies and institutions. Of this number, 554 were purchased and 1,098 were received by gift or exchange. The whole number of additions to this class, including annual reports of societies and institutions, numbered between 4,000 and 5,000 titles. Since so large a proportion of the scientific work of the world appears in periodicals and society publications, the value of this form of literature is evident, and it is necessary, therefore, to increase as far as possible the resources of the Library in this respect. During the next fiscal year the services of a larger number on the Library staff will be required to continue and to still further develop this work of completing imperfect series, adding new ones, and of increasing the exchange list.

Progress has been made on the supplement to the Catalogue of Periodicals and other Serial Publications in the Department Library, which was published in 1901. As the edition of the catalogue of 1901 is exhausted, it is planned during the coming fiscal year to have this catalogue reprinted and, in addition, to publish a supplement containing a list of the periodicals added to the Library during the years 1900 to 1905, inclusive.

#### BINDING.

The number of volumes bound in the past year was 2,463, an increase of 521 as compared with the previous year. In order to keep the binding of current periodicals up to date and to bind miscellaneous volumes still unbound on the shelves, the number bound each year should be twice that already reached. Scientific periodicals are among the most expensive publications, and for this reason there is great need of binding them promptly to prevent loss of single numbers, which often can not be replaced without much additional expense of time and money.

The binding of at least 3,000 volumes annually is much to be desired and could be accomplished in so far as the preparation of the volumes in the Library is concerned, but the lack of sufficient funds to meet the cost of binding restricts the necessary extension of the work.

#### INDEX CARDS TO DEPARTMENT PUBLICATIONS.

In April, 1906, an important change was made in regard to the printing and distribution of the index cards for Department publications, which work was done previous to that date by the Library. On account of the lack of necessary space in the Library, the difficulties connected with the distribution of the cards had become so great that it was necessary to make some change. The Library of Congress

being fully equipped to carry on such work on a large scale for itself, it was deemed advisable to arrange for our own work in this line to be done by that Library, thus saving by cooperation much time and reducing expense. The arrangement agreed upon was that the indexing of the publications should be continued by the Department Library, the proofs also to be read by the Library; but the mechanical processes, the printing and distribution of the cards should be transferred to the Library of Congress. The following letter of information was sent to all the libraries which had hitherto received the index cards:

Notice is hereby given that after the distribution of cards for Yearbooks for 1904 and for Farmers' Bulletins 203 to 226 the free distribution of printed catalogue cards for publications of the Department will be discontinued, except to agricultural colleges and experiment stations in the United States.

The demands for these cards have become so numerous that it is necessary, on account of the increased expense involved, as well as on account of the limited space in the Library to handle the cards, to transfer the work of printing and distribution to the Library of Congress. The cards which will be provided by the Department for the agricultural colleges and experiment stations will be forwarded direct from the Library of Congress.

Libraries and individuals desiring cards for publications of the Department issued since January 1, 1906, and for other publications not hitherto indexed may obtain them at the price and in the manner stated in the inclosed bulletin. [Library of Congress, Card Section, Bulletin No. 14.]

The special advantage to the subscribers to the cards in this new method of distribution will be the receipt of cards nearly as soon as the publications are received.

This catalogue of Department publications is practically up to date and furnishes to depository and other large libraries a key to the documents of the Government most frequently used by the general public. Libraries which have received these cards up to January, 1906, free of cost, can now keep the index up to date at a nominal expense. In connection with this work the cooperative methods employed with the Library of Congress have been most satisfactory in every respect, benefiting in its results the public libraries throughout the country as well as this and other Department libraries.

#### INDEXING AGRICULTURAL LITERATURE.

In addition to the cataloguing of the Department publications the Library has continued the indexing of certain important agricultural periodicals. In the past year cards were prepared for *Die Landwirtschaftlichen Versuchsstationen*, Band 57-64, 1904-5; *Landwirtschaftliche Jahrbücher*, Band 33-35, 1904-5; and *Annales de la Science Agronomique*, 1905. The entire sets of these three periodicals are, therefore, indexed up to the current volumes, and the printed index cards are available for purchase at a very moderate cost. The cards can be purchased in complete sets for each or for all these publications, or, if desired, the cards for any subject covered by these periodicals. Other publications of equal value will be added to this list from time to time that their usefulness may be increased.

#### LIBRARY PUBLICATIONS.

The publication of the quarterly bulletin entitled "Accessions to the Department Library" has been continued and the four bulletins for the past fiscal year comprise 252 pages. The increasing demands for this publication indicate that it is valued outside the Department as a current bibliography of agricultural and scientific literature.

## USE OF THE LIBRARY.

It has not been practicable and it is scarcely possible to keep an account of the number of books used by readers in the main library but not taken from the room, and, therefore, not charged at the loan desk. Nor has it been possible to keep statistics of the daily use of books deposited in the several Bureaus and Divisions of the Department. For these reasons the statistics of the books charged at the loan desk do not adequately represent the use of the Library. The charges that were made at the loan desk numbered 18,136 in the last fiscal year, an increase of 4,387 as compared with that of the previous year. The records of the loan desk do not include the statistics of the circulation of the single unbound numbers of periodicals which, if kept, would fully equal the circulation of bound books.

The record of the number of books loaned to scientists outside of Washington shows that 138 books and periodicals have been loaned. Investigators connected with colleges and experiment stations in the following twenty-six States and Territories—Arizona, Colorado, Connecticut, Florida, Hawaii, Illinois, Iowa, Maine, Maryland, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, South Carolina, Tennessee, Texas, Vermont, Washington, West Virginia, Wisconsin, and Wyoming—have received assistance in this way without inconvenience to the scientists of the Department. The Library has, in turn, been the recipient of many favors in the matter of inter-library loans from university and reference libraries in Chicago, St. Louis, Cambridge, and Boston, in addition to those from the Library of Congress and other Government libraries.

## RECOMMENDATIONS.

In view of the tendency to centralize the purchase of all books for use of the Department in Washington a larger appropriation is needed to provide for such expenditures as the Library has not been called upon to meet heretofore, as well as for the annual growth of the Library for the advancement of current investigations. The Library is so vitally related to every Bureau, Division, and Office of the Department and the demands made upon it being already more numerous than it can meet, it is urgently recommended that more ample provision be made for increasing its resources. Also, the staff has not increased in number in proportion to the growth of the Library, so that another trained assistant is much needed to still further develop by indexing and by bibliographies the usefulness of the present extensive and technical special collections.

Each year this unsurpassed library of agricultural and scientific literature becomes more valuable, and that adequate and safe housing, together with suitable work and reference rooms, should be provided for its preservation and greatest usefulness needs no argument.



## REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., October 16, 1906.*

SIR: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1906.

Respectfully,

A. C. TRUE, *Director.*

HON. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR, WITH RECOMMENDATIONS.

#### DEVELOPMENT OF WORK OF OFFICE OF EXPERIMENT STATIONS.

As a consequence of the passage of the act of Congress of March 16, 1906 (Adams Act), the work of the Office of Experiment Stations has been materially broadened and increased. Aside from the increased responsibility involved in the supervision of the appropriations given to the experiment stations under this act, much additional work has been laid upon the Office through the increasing disposition of the station managers and workers to ask its advice and assistance in a variety of ways pertaining to the strengthening of their work and the enlarging of their staffs and equipment. The scope of the Experiment Station Record has been somewhat enlarged by the establishment of new departments, and every effort has been made to review the literature of agricultural science as comprehensively as the means at our disposal will permit.

The demand for the services of this Office in aiding the widespread movement for the more thorough diffusion of agricultural education among our people has been far greater than could be met with the present resources of the Office. This demand covers the entire range of agricultural education from graduate instruction to the most elementary forms of extension work. During the year the Office has taken part in the second session of the Graduate School of Agriculture, has visited numerous agricultural colleges and schools, has assisted in the inauguration of secondary and elementary courses in agriculture in public schools, has addressed thousands of teachers on the importance and value of instruction in agriculture, has aided the introduction of nature-study and school gardens in city schools, has systematically cooperated with the State directors of farmers' institutes in efforts for the improvement of the American system of agricultural education for adult farmers, has cooperated with the Association of American Agricultural

Colleges and Experiment Stations in studies of the pedagogics of agriculture, and has prepared a number of publications on topics relating to agricultural education. Congress has granted the authority for the prosecution of this work and the Office has a skeleton organization for this purpose. If the appropriation recommended in this report is granted by Congress, the Office will be ready to promptly enlarge its educational work along lines of assured usefulness, but until its funds are increased its work in this direction must be very limited and in large measure unsatisfactory.

Steady progress has been made in the work of the experiment stations in Alaska, Hawaii, and Porto Rico, and these institutions are now more generally recognized as important factors in the agricultural development of these regions. The work in Alaska has been enlarged by the beginning of systematic experiments in cattle raising and with orchard and small fruits. The prospect of material extension of railroad transportation in Alaska in the near future is giving an added interest to problems connected with agricultural development there. In Hawaii tobacco experiments have been quite successful, and the discovery that local feeding stuffs are deficient in lime is likely to be of much importance to the live-stock interests of that Territory. With growing interest in the diversification of Hawaiian agriculture, the services of the station are in greater demand. The Porto Rico Station has extended its work on rice, coffee, tobacco, forage crops, citrus fruits, mangoes, cacao, and other horticultural plants, and useful results have already been obtained. The station is getting into closer touch with the planters throughout the island.

The studies of the nutritive value of agricultural products used as human food have been continued at centers of investigation established in different parts of the country. The most extensive investigation during the past year has been on the nutritive value of Cheddar cheese at different stages of ripening. This has been conducted in cooperation with the Bureau of Animal Industry, and has included numerous digestion and respiration-calorimeter experiments. More data have been obtained than in similar studies made elsewhere, and the results, in general, establish the high nutritive value of well-made cheese on a thoroughly scientific basis. With cereals, especial attention is now being given to comparative studies of the relative food value of different corn products. Other studies include the comparative digestibility of meats cooked in different ways; the nutritive value of fruits and nuts; the rôle of the mineral constituents in the diet. Efforts are being made to secure the more thorough utilization of the results of these investigations in schools, hospitals, and other public institutions, and households generally.

The irrigation and drainage investigations of this Office have been materially extended in response to urgent demands from many parts of the country. Public interest in the reclamation of land by irrigation is now about equaled by interest in similar work by drainage. The utilization of a limited water supply is an absorbing problem in many sections of the arid and semiarid regions, and the need of irrigation to supplement "dry farming" is increasingly apparent. The construction of large storage reservoirs by both Government and private enterprise is calling attention to the agricultural problems requiring solution in order that the lands under these reservoirs may be profitably farmed. The large movement of population into the

new irrigated regions, which is already under way, is creating a great demand for information regarding irrigation methods and appliances adapted to these regions. This Office is collecting and disseminating such information as far as its resources will permit. The interests involved in the wise and efficient settlement of the problems involved in the extension of our agriculture, through irrigation and drainage, are so great that this Office should be put in a position to secure and retain the ablest experts in order that its work within the lines assigned to it by national legislation shall be first class in every respect.

#### RELATIONS WITH THE AGRICULTURAL EXPERIMENT STATIONS.

Important additional duties have been given to this Office in its relations with the agricultural experiment stations as the result of the passage of an act of Congress providing "for an increased annual appropriation for agricultural experiment stations and regulating the expenditure thereof." This measure, which was introduced in the House of Representatives by the late Hon. Henry Cullen Adams, of Wisconsin, passed by both Houses of Congress without a dissenting vote, and approved by the President March 16, 1906, provides for a large and permanent increase in the Federal funds granted to the several States and Territories for the use of the experiment stations. Under the terms of this act the Secretary of Agriculture must annually "ascertain and certify to the Secretary of the Treasury as to each State and Territory whether it is complying with the provisions of this act and is entitled to receive its share of the annual appropriation for agricultural experiment stations under this act, and the amount which therefore each is entitled, respectively, to receive," and "make an annual report to Congress on the receipts and expenditures and work of the agricultural experiment stations in all of the States and Territories, and also whether the appropriation of any State or Territory has been withheld, and, if so, the reason therefor." He is also charged in general terms "with the proper administration of this law." On March 20, 1906, the Secretary of Agriculture sent a letter to the directors of the agricultural experiment stations in the several States and Territories in which he stated that "the Director of the Office of Experiment Stations is hereby designated my representative in all matters relating to the business of this Department in connection with the administration of this law, and the Office of Experiment Stations will aid in promoting effective work under this act in the same general way as it has heretofore in relation to the Hatch Act." At the same time the Secretary made the following announcement of the policy to be pursued by this Department in the administration of the Adams Act:

Under the terms of the act it will be necessary that a separate account of the Adams fund shall be kept at each station, which should be open at all times to the inspection of the Director of the Office of Experiment Stations or his accredited representative.

In the interpretation of this act and the examination of the work and expenditures of the stations under it, I have instructed the Director of the Office of Experiment Stations to be guided by the following principles:

The Adams fund is "to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States." It is for the "more complete endowment and maintenance" of the experiment stations, presupposing the provision of a working plant and administrative officers. Accordingly, expenses for administration, care of buildings and grounds, insurance, office furniture and fittings, general maintenance



of the station farm and animals, verification and demonstration experiments, compilations, farmers' institute work, traveling, except as is immediately connected with original researches in progress under this act, and other general expenses for the maintenance of the experiment stations are not to be charged to this fund. The act makes no provision for printing or for the distribution of publications, which should be charged to other funds.

In order that there may be no doubt as to the disposal of the Adams fund, each station should outline a definite programme of experimental work to which it will devote this fund, and expenses for other work should not be charged to it. The work contemplated by this act will, as a rule, necessarily cover more than one year, and changes in the programme once adopted should not be made until the problems under investigation have been solved or their solution definitely shown to be impracticable. This will give ample opportunity for making plans for winding up any particular piece of work and beginning another with such deliberation as will provide for the suitable and economical expenditure of this fund without resort to doubtful expedients or expenditures. It is much to be desired that this fund shall be a strong incentive to the careful choice of problems to be investigated, thorough and exhaustive work in their solution, and the securing of permanent and far-reaching results on which can be safely based demonstration and verification experiments leading to the general improvement of farm practice in many particulars.

At the time of its passage it was generally understood that the Adams Act provided for an appropriation for the fiscal year ending June 30, 1906, but the Comptroller of the Treasury ruled that by the terms of the Act the first appropriation made was for the succeeding fiscal year. To remedy this defect in the law the Secretary of Agriculture asked Congress to pass additional legislation, and this was done in connection with the appropriation act for this Department for the fiscal year ending June 30, 1907, which contains a clause stating that the Adams Act "shall be construed to appropriate for each station the sum of five thousand dollars for the fiscal year ending June 30, 1906," and \$2,000 additional for each of five succeeding fiscal years. This appropriation act did not pass until June 30, 1906, but warrants were immediately drawn by the Secretary of Agriculture for the payment of the initial appropriation under the Adams Act to the 48 States and Territories entitled to its benefits. These warrants were accepted by the Secretary of the Treasury, and the experiment stations in the several States and Territories promptly received the sum granted them by the new law. This Department also ruled that these funds might be applied to any expenditures made by the stations between March 16 and June 30, 1906, which could properly be charged to the Adams fund. The stations were able only partially to comply with the conditions of the act as thus interpreted as regards the initial appropriation, and settlement of their accounts for the Adams fund for the past fiscal year are now being made through this Office.

It is already evident that the business of this Office in relation to the work and expenditures of the stations under the Adams Act will be considerable in amount and will have much importance as a factor in determining the kind of progress to be made by these institutions. The organization of lines of work which may fairly be called "original research" in agricultural problems will occasion much discussion as regards the nature and scope of such work as related to conditions existing in the several States and Territories, the men to be selected as investigators, the means and appliances needed to make the work undertaken successful, etc. The policy of the Office, as heretofore, will be to endeavor to formulate and hold to such general principles in the administration of the Adams Act as seem most likely to secure the efficient use of the Adams fund for research work of a high and

substantial character, and at the same time to safeguard the autonomy of the stations and raise their work and its results in the estimation of their farmer constituencies. This will involve much additional correspondence and personal conference in order that the best results may be obtained. Through the cultivation of more thorough acquaintance with the managers and workers of our stations, and through participation in the councils of the Association of American Agricultural Colleges and Experiment Stations, this Office hopes to be able to act as a gatherer and disseminator of sound views regarding the aims and methods of research work in agriculture in such a way that its utterances will have behind them the substantial consensus of the men best qualified to judge of the needs and requirements of American agriculture as related to the work of agricultural experiment stations, whose work shall rest on a firm basis of scientific principles and their application to practical ends. With the enlarged work of the stations, due to the increase in both Federal and State funds for their support, it is very desirable that this Office shall be in a position which will enable it to devote sufficient time to its visitation of the stations and to conferences and correspondence with their officers, so as to get a just and adequate knowledge of the actual needs and requirements of these institutions, to aid most effectively in the promotion of their interests, and to make a definite and reliable report to Congress of their receipts, expenditures, and work, as required by law. To do this properly will require some addition to the funds for the maintenance of this Office, and I have therefore recommended that \$5,000 be added to the lump sum appropriated for the general business of the Office.

In announcing the passage of the Adams Act the Secretary of Agriculture made the following statement regarding the policy of this Department as regards the Hatch Act and the encouragement of State and local appropriations for agricultural experimentation and education:

No change will be made in the attitude of this Department toward expenditures under the Hatch Act. The Hatch fund should be as carefully guarded as ever, and be devoted to substantial experimental work and the printing and dissemination of the results of such work.

The increased liberality of the Federal Government in providing for the endowment of research and experimentation in agriculture should be a further incentive to the States and local communities to supplement these funds for the extension of demonstration experiments, farmers' institutes, agricultural colleges, schools, and courses of instruction, and the general education of the rural communities along industrial lines, in order that the masses of our farmers may be so educated from early youth that they will appreciate the benefits of original research and experimentation as applied to agricultural problems, and be able to appropriate in the most effective manner for their own benefit and the general welfare of the nation whatever practical results are obtained from the work of the agricultural experiment stations.

This Office has therefore continued to make careful inquiry regarding the use made by the stations of the funds granted to them under the Hatch Act, and to aid them in securing liberal State and local appropriations for cooperative and other experiments in different localities, for publishing the results of their work, and for such practical tests and demonstrations as will best show how the results of agricultural research may be applied in a broad way for the improvement of agricultural practice. The States and local communities have of late shown a most encouraging disposition to give the stations such financial support as they require to make the results of their work broadly effective, and it is believed that this will continue to be done wherever

the station managers show themselves alert to the best interests of agriculture and worthy of the confidence and support of practical men.

The tenth annual examination of the work and expenditures of the agricultural experiment stations which receive the national funds appropriated under the act of Congress of March 2, 1887 (Hatch Act), with special reference to the fiscal year ended June 30, 1905, was made during the past year in accordance with the authority conferred upon the Secretary of Agriculture by Congress, and a report of this investigation, as required by law, included in the annual report of this Office for 1905.

As heretofore, the report was based upon three sources of information, viz, the annual financial statements of the stations rendered on the schedules prescribed by the Secretary of Agriculture in accordance with the act of Congress, the printed reports and bulletins of the stations, and the reports of personal examinations of the work and expenditures of the stations made during the year by the Director, Assistant Director, and two other expert officers of the Office of Experiment Stations.

The Assistant Director has continued to have special supervision of the business of the Office connected with the work and expenditures of the stations.

This Office has continued to follow and record the progress of agricultural experiment stations in foreign countries and to publish accounts of their organization, resources, and work in the Experiment Station Record and elsewhere.

#### RELATIONS WITH INSTITUTIONS FOR AGRICULTURAL EDUCATION.

The movement for agricultural education in the United States has become so broad and the demands on this Office for services in aid of this movement have become so varied that it has been deemed best to divide the educational work of the Office into two sections. One of these deals with the agricultural colleges and schools; the other promotes the interests of the farmers' institutes and other forms of extension work in agriculture.

##### THE AGRICULTURAL COLLEGES AND SCHOOLS.

The work of this Office relating to the agricultural colleges and schools during the past year has included (1) the collection and publication of information regarding the progress of agricultural education at home and abroad; (2) studies of different grades of American and foreign schools in which agriculture is taught; (3) work in cooperation with the Association of American Agricultural Colleges and Experiment Stations and other important associations dealing with educational matters; (4) the giving of aid to agricultural colleges and schools and to State and local school authorities along lines of agricultural education.

(1) In order to follow and record the progress of agricultural education in the United States and foreign countries more effectively a department of agricultural education was established in the Experiment Station Record beginning with Volume XVII, in which abstracts of important text-books, manuals, and other publications relating to this subject are published monthly, together with notes on



the agricultural colleges and schools in this and other countries. This new feature of our work has met with the cordial approval of such educators as have access to the Experiment Station Record, but has fallen far short of accomplishing the greatest possible good, owing to the fact that the Record is available to only a part of our educational and agricultural leaders. It is desirable, therefore, to devise some means of bringing these educational summaries and notes to the attention of a much larger number of people.

There have also been prepared and published the annual statistics and organization lists of the agricultural colleges and experiment stations, a bulletin on School Gardens, a review of progress in agricultural education in 1905, and a Yearbook article on "The use of illustrative material in teaching agriculture in rural schools."

(2) The work of card indexing references to American and foreign schools in which agriculture is taught has been continued. The number of cards now completed is about 3,300, of which about 2,300 were added during the past year.

(3) The educational work in cooperation with the Association of American Agricultural Colleges and Experiment Stations has been reorganized and put upon a better basis. At the convention of this Association in Washington, D. C., in 1905, the standing committees were reorganized in accordance with the recommendation of the executive committee. The Association now has four standing committees, viz, (1) instruction in agriculture; (2) graduate study; (3) extension work; (4) experiment station organization and policy. The Director of this Office was made chairman of the committee on instruction in agriculture, and, upon invitation of the committee, Mr. Dick J. Crosby, of this Office, became its secretary. The Director continues to act as bibliographer of the Association, and presented before the section on college work and administration a paper on "The land-grant colleges and the public schools."

In accordance with the report of the committee on graduate study the association decided to assume responsibility for the continuance and management of the Graduate School of Agriculture. Arrangements were made to hold the second session of this school at the University of Illinois in July, 1906, and upon invitation of the committee and the consent of the Secretary of Agriculture the Director of this Office accepted the position of dean of the school. The school did not open until after the close of the fiscal year 1905-6, but all of the work of arranging the courses and organizing the staff of instructors was done before the close of the fiscal year. This involved much correspondence and attendance upon several conferences of the committee and of the officers of the University of Illinois. This session of the graduate school was very successful. Courses in agronomy, horticulture, plant physiology and pathology, zootechny, and breeding of plants and animals were given, which were attended by 131 men from 34 States and Territories, Hungary, and India.

Concerning the educational work of this Office, the Association adopted the following resolution:

*Resolved*, That this association recognizes the great value of the work of the Office of Experiment Stations in promoting the cause of agricultural education in the United States, and heartily indorses the action of the Secretary of Agriculture in encouraging and aiding the efforts of the Office in this direction.

Another important action of the association was to instruct its executive committee to take steps to secure the consent of the National Educational Association to add to its list of special departments a department or departments on rural and agricultural education. The preliminary correspondence relating to this matter has been conducted through this Office, and arrangements have been completed to present the application for the new department at the next convention of the National Educational Association.

The Department of Superintendence of the National Educational Association, at its annual meeting held in Louisville, Ky., February 27 to March 1, 1906, devoted one section meeting to a conference on agriculture in public schools. As a result of the conference, the following resolution was adopted:

*Resolved*, That the Department of Superintendence of the National Educational Association is in hearty accord with that part of the report of the Hon. James Wilson, Secretary of Agriculture of the United States, in which he encourages the teaching of elementary agriculture in the public schools, and respectfully requests Congress to grant the appropriation of \$13,620, which he has asked for to enable him to investigate and report upon the progress and present condition of agricultural instruction and institutions in this and foreign countries.

This Office has continued to cooperate with the American Civic Association in promoting the school-garden movement, Mr. Crosby being vice-president in charge of the Department of Children's Gardens.

(4) The giving of aid to agricultural colleges and schools and to State and local school authorities along lines of agricultural education is an item of work which is constantly increasing in importance and draws more and more heavily upon the time of the Office force. Rapid growth of the institutions devoted to agricultural education and research results in frequent changes in their organization, both by the addition of new officers and by the transfer of officers from one institution to another. In a large percentage of cases where such changes occur this Office is consulted regarding suitable men to fill positions. This involves a large amount of correspondence and necessitates an intimate acquaintance with the qualifications of scientific men throughout the country. In order to facilitate this work, the Office of Experiment Stations maintains a card directory (the Agricultural Science Register) of teachers and investigators in agriculture, showing their training, experience, and other qualifications. This directory of about 1,200 entries was completely revised early in the year, and about 200 additional entries have been made. The Office has also carried on a large correspondence with agricultural college authorities concerning changes in organization, courses of study, etc., and its officers have visited nearly all of these colleges during the year.

The most time-consuming educational work of the Office probably has been its efforts to assist State and local authorities in organizing and starting agricultural courses in connection with secondary and elementary public schools, but the widespread and insistent demand for agricultural instruction in these schools and the importance of starting such work along right lines so that the mistakes and failures of earlier efforts in this direction may be avoided render it highly desirable that this Department make strenuous efforts to meet the demands made upon it for such assistance. During the past year the Office has met every demand of this nature that could be met with available facilities.

The Director of the Office, for example, was asked to go to California last Christmas vacation to attend a joint meeting of the State Teachers' Association and the State Farmers' Institute. At this meeting about 7,000 people gathered at the University of California to consider among other things the question of promoting industrial education. The feasibility of introducing agriculture into the schools was discussed and at the request of the officers in charge of the meeting the Director of this Office outlined a general plan for organizing such work, with the result that a committee was formed to investigate the whole matter. This committee asked the Office of Experiment Stations for assistance in formulating a scheme for agricultural education in the schools of the State, and such a scheme has been prepared and published.

In Kansas there is a system of county high schools—good schools, well equipped and maintained, but giving very little attention to industrial courses. These schools have maintained business courses, normal courses, and college preparatory courses, but no farm preparatory courses. A member of the State board of education thought that agriculture ought to be taught in schools attended largely by farmers' sons, and he appealed to the Secretary of Agriculture to aid in starting agricultural courses. The Secretary sent a man from the Office of Experiment Stations who is familiar with such matters to one of the counties to take the matter up with the local school authorities. In company with the county superintendent of schools and one other influential man this man drove over the whole county, explaining to farmers what might be done along the lines of agricultural education. Before leaving the county he helped the school officers to outline a course of study and made arrangements with local implement dealers to give the boys instruction regarding agricultural machinery. As a result an agricultural course is now in operation in the Norton County high school, with a graduate of the Kansas State Agricultural College in charge of the course, and other county high schools in the State are preparing to take up the work.

Upon invitation of the State superintendent of public schools in Maine a member of the Office staff visited the five normal schools in that State, giving addresses on the teaching of agriculture in public schools and conferring with the normal school officers regarding the starting of such work in these schools, and thus preparing teachers capable of giving instruction in agriculture in the public schools.

These are examples of the kind of educational work the Office is called upon to do, and they also serve to show how widespread is the interest in the subject of agricultural education. During the year members of the Office staff gave over twenty-five addresses on different phases of this subject before associations interested in education, and also attended a number of conferences and round-table discussions on agricultural education. Several of these addresses were illustrated and involved the preparation of lantern slides, of which the Office now has about 250 on agricultural education. In several instances the Office loaned sets of these slides to lecturers, but it could not meet all demands for such assistance.

#### PLANS FOR 1906-7.

It is planned to continue the educational work now in hand and to make such extension of it as will be possible without additional funds. In the appropriation act for this Department for the current fiscal



year Congress provided for an investigation and report upon the organization and progress of agricultural schools in this country and abroad, but did not provide funds for carrying on this work. Mr. Dick J. Crosby has been put in charge of the work relating to agricultural colleges and schools, but in view of our financial limitations will be able to give only a part of his time to this work.

The department of agricultural education in the Experiment Station Record will be continued for the present. This arrangement, however, is not entirely satisfactory, owing to the fact that the Record is available only to officers of the agricultural colleges and experiment stations and does not reach the large number of school officers, teachers, and others who are not connected with these institutions but are greatly interested in agricultural education. It has been suggested that provision be made for a separate serial publication on agricultural education to be sent free to all school officers and teachers who request it, and it is hoped that means may soon be available for doing something of this kind. Such an arrangement, aside from the possibility of reaching larger numbers, would possess several other advantages over that now in operation. More extended reviews of important publications could be given. The Record is now so crowded for space that abstracts of important American publications are frequently reduced to bare outlines, while many foreign publications can be given by title only. A separate publication in which there would be opportunity to show the nature and scope of the articles reviewed would greatly enhance the value of this work of the Office. Such a publication would also serve to render widely available the work of the men who are engaged in preparing courses of study, exercises, experiments, and other material for use in college and school courses. These publications, at the best, are now available only to those in the States where this work is being done, and there is no agency engaged in disseminating widely the information they contain. Some of the information is of such general interest that it should be spread over the country, and no organization is in such a good position as this Office to do this work.

An inquiry concerning the influence of seedsmen and nurserymen in extending the school-garden movement has recently been taken up.

The work of the year in cooperation with the Association of American Agricultural Colleges and Experiment Stations will be continued mainly along three lines: (1) The preparation of agricultural courses suitable for secondary schools of agriculture; (2) the preparation of college courses in rural engineering; (3) the collection of material to form the basis for a future report on college courses in home economics. This work will involve considerable correspondence and some study at first hand of institutions now offering the courses under consideration.

The Office will continue as heretofore to render such aid as it can to agricultural colleges and schools and to school officers and educational associations. Work along these lines will be greatly facilitated when it is found possible to issue a regular publication devoted to agricultural education as outlined above. In this connection two projects have recently been outlined and work upon them will be undertaken as soon as feasible. These are (1) inquiry concerning the available facilities for preparing teachers of elementary agriculture, and (2) a

study of negro schools of agriculture and means of improving them. There is an increasing demand for field work in agricultural education, but not much extension of this work can be made until additional funds are available for this purpose. Numerous requests for addresses at important educational meetings and for lectures on elementary agriculture at teachers' institutes during the summer and autumn have already been received. Through the courtesy of Prof. Milton Whitney, Chief of the Bureau of Soils, the Office has been able to send Mr. H. O. Sampson, of that Bureau, to lecture for three weeks at two teachers' institutes in Wisconsin, one week at a teachers' institute in Pennsylvania, and one week at a teachers' institute in Maryland. Mr. Sampson's experience as a teacher of elementary agriculture in a small high school in Pennsylvania has given him good preparation for this work and he has been well received.

At a time like the present, when efforts are being made in so many different States to introduce agriculture into the public schools, and when so much preliminary work must be done in the way of preparing teachers for this work, the Office of Experiment Stations should be in a position to send men of experience in teaching elementary agriculture to important teachers' institutes and summer schools for teachers where elementary agriculture is to be taught. Different States are not in a position to do this work effectively. There are but few men in the United States qualified for it, and the time of these men should be utilized to the best possible advantage. It would seem to be the part of wisdom and economy if these men were where arrangements could be made to utilize their time fully and profitably in this work for the benefit of the whole country.

#### THE FARMERS' INSTITUTES AND EXTENSION WORK.

Since the farmers' institutes constitute one phase of a general movement for bringing up-to-date information on agricultural subjects to our adult farmers and their families and thus greatly extending the educational work done by the agricultural colleges and schools, this Office has naturally been called upon more and more to aid various forms of educational effort which are conveniently grouped together under the term "extension work in agriculture." Such aid along this line as the Office has been able to give has appropriately been under the immediate direction of the farmers' institute specialist, Prof. John Hamilton.

#### COOPERATIVE EXTENSION WORK.

As previously stated, the American Association of Agricultural Colleges and Experiment Stations has appointed a standing committee on agricultural extension work, and Professor Hamilton has been made the secretary of that committee. On this cooperative plan an investigation is being conducted to ascertain to what extent extension work in agriculture is being done by colleges, schools, State departments of agriculture and education, agricultural organizations, the press, and other agencies throughout the United States. The numerous replies to our circular of inquiry show that such work is being done under a considerable variety of forms, but that in most cases it lacks efficient organization and methods. There is also great need of suitable publications and illustrative materials for work along these lines. Little has

been done thus far except to arouse interest among a considerable number of farmers in the work which is being done on their behalf by scientific and educational agencies. It yet remains to devise and carry out on a broad scale a system of extension in education which will meet the needs of the twentieth-century farmer. To aid the agricultural leaders in the several States and Territories to put this work on an efficient basis is the purpose of this Office, provided it can secure the necessary force and equipment. In order to do this the Office should have a small force of experts who can study the pedagogical problems involved in agricultural extension work, consult and cooperate with the State authorities and leaders in agriculture and education, prepare publications, charts, and illustrative material for use in extension work, and make demonstrations of appropriate methods for such work before representative assemblies in the various States.

#### THE FARMERS' INSTITUTES.

The condition of the farmers' institute work throughout the country, as shown by such of the reports of the State directors as have been received, is gratifying. There has been an increase in the number of sessions of institutes held by the twenty-two States and Territories reporting of about 6 per cent over the previous year and of over 9 per cent in the attendance. If the States not yet reported show like increase, there will be a total addition of 633 sessions and of 89,567 persons in attendance. This would bring the total number of sessions for the year to 11,188 and the attendance to 1,084,757.

All of the States and Territories, excepting Alaska, are now holding institutes. The States in which the institutes have been longest in operation are enlarging the scope of their work to include boys' and girls' clubs, women's domestic science organizations, and rural school work. Several States have held schools of instruction for their institute workers, and, in three, special schools upon a single topic have been held, continuing through several days.

#### MOVABLE SCHOOLS OF AGRICULTURE.

To supplement the farmers' institutes by providing more definite instruction on particular agricultural subjects, it has been found desirable in England, France, Belgium, and other European countries to arrange short courses of from 10 to 20 lessons which might be given in different localities under the direction of competent instructors. Thus, a course in butter making might be given in a dairy region, a course in apple or peach growing in a horticultural region, etc. To bring this matter definitely to the attention of the friends of agricultural progress in the United States, this Office has undertaken the preparation of a few such courses suited to American conditions. A course in cheese making for movable schools of agriculture, prepared by Dr. L. L. Van Slyke, of the New York State Agricultural Experiment Station, an eminent expert on this subject, has been published as Bulletin 166 of this Office. The course consists of 14 lectures, with references and a corresponding number of practice exercises.

Great care was taken in the preparation of this course to have it in proper pedagogic form. The difficulty of condensing the subject into comparatively few lectures, and at the same time insuring its reasonably full treatment, was partially overcome by the liberal use of ref-



erences by the lecturer to authorities, indicating the volume and page where extended descriptions may be found.

Immediately following the lecture and preceding each practice exercise, a period of several hours is expected to be given for looking up authorities and for collateral reading. No notes are to be taken during the delivery of the lecture, but at its close a syllabus with all of the references will be handed to each student. In this way the undivided attention of the members of the class can be given to the substance of the subject treated without their being compelled to devote their time to the mere manual operation of transcribing.

The practice exercises are upon the points presented in the lecture and vary in length from one to four hours, according to the nature of the subject. A complete list of apparatus needed and of books of reference is given in the bulletin, thus enabling the character and cost of equipment to be ascertained and provided for. The complete outfit for 15 students, including the library of reference, need not exceed in amount from \$400 to \$500.

Five other courses are in preparation: Poultry rearing, fruit growing, butter making, farriery, and domestic economy. Each of these courses will be modeled after the form of the one now issued, so far as its pedagogic features are concerned.

#### CHARTS FOR ILLUSTRATION.

Arrangements have also been completed for the preparation of a set of 15 charts illustrating the selecting of cattle for feeding. Each chart is to be 42 inches square, and all of the representations are to be of a size sufficient to be readily distinguished at a distance of 100 feet. Only one subject is to be represented upon any chart. The illustrations on 10 of these charts are to be in color, prepared by a competent animal artist. The remaining 5 charts are to contain outlines of animals, showing, among other items, divisions of the carcass as cut up by the butcher, with the prices of the several parts. A syllabus of a lecture upon the subject will be printed upon one of the charts and also such lists of books, reference tables, and other data as may be needed for the full understanding and study of the subject. This set is intended to be a model that may be followed in the treatment of other subjects, and is also to be used as a copy from which lithographic representations may be made whenever sufficient funds can be secured for the purpose.

Charts of this character, well executed and printed in color, are much needed by those who are engaged in farmers' institute lecture work, as well as by teachers in schools and colleges where agricultural subjects are taught. Sets of fifteen charts could be furnished by the Government after the first cost is met at a very moderate price. If properly prepared, there is reason to believe that a considerable number could be sold. The preparation of the plates and the printing, backing with linen, and binding 2,500 copies of each set of the charts would cost about \$1,000.

#### SPECIAL RAILROAD TRAINS.

Special railroad trains, equipped with lecturers, charts, specimens, books, bulletins, and demonstration material, have been sent out in fourteen States. This movement in extension work, begun in the

Western States three or four years ago with corn as the subject, has extended to the East and South, and instruction is now given in this way upon a wide range of topics adapted to the agricultural conditions of the several sections. The Farmers' Institute Specialist accompanied one of these trains last spring through a portion of Illinois. The train was furnished by the Illinois Central Railroad Company and consisted of a locomotive, baggage car, two coaches, one dining car, and a compartment sleeper. The company bore all of the expenses excepting the salaries of the lecturers, which were met by the University of Illinois. Although the country roads were deep with mud, the attendance at the stations at which the stops were made was all that could have been desired, ranging in number from 150 to 400. One day, by actual count, the attendance was over 3,500.

Reports of similar manifestation of interest have come in from every State in which these trains have been sent out. The novelty of the method has no doubt had something to do with the attendance, but there seems also to have been, as evidenced by the close attention given to the lecturers and by the questions asked, a real desire for information.

Perhaps the most significant feature of this movement is the interest that the transportation companies are taking in agricultural education, or at least in the dissemination of agricultural information. In every instance prominent railroad officials have accompanied these trains and have assured the farmers of their interest in promoting the welfare of the farming people.

A recent investigation by the Farmers' Institute Specialist into what the railroad companies of the United States are doing in aid of agriculture discloses the fact that, with few exceptions, they are coming as never before to appreciate this source of traffic, and quite a number of companies have already begun the organization of departments for the aid and encouragement of this industry. One company has three expert specialists and two assistants, who give their entire time to instructing and otherwise aiding the farmers. This company also publishes a monthly magazine giving information with respect to farm lands and methods of culture. Another company has been instrumental in organizing fruit growers' and truckers' associations at different points along its road and issues printed circulars and bulletins of information respecting the agricultural advantages of the several localities through which the road passes. This company also employs experts to teach the trucker and farmer and to oversee and assist him in his work. Some of these experts have had training in our agricultural colleges and experiment stations and others are commercial men of years of experience, who aid in marketing produce and assist by teaching the fruit growers and truckers how to grade, pack, and prepare their products so as to suit the peculiar demands of the various cities. This road has a soliciting freight agent in every northern city of any magnitude. The agent posts the fruit growers' associations and individual growers daily, and oftener if required, as to the exact condition of the market in the city where he is located. He advises of the arrival of the cars, the condition of the contents, and often gives the prices which were obtained for the consignment before the consignee reports the arrival of the car.

Another company has distributed along its lines 800 pure-bred bulls and 6,000 pure-bred pigs for breeding purposes, and it also offers prizes

for the best managed farms in the several districts through which it runs.

A western company has organized 35 farmers' institutes and truck growers' associations. Another reports 18 such organizations in its territory. In Texas the railroads have associated for the development of the industries of the State and are encouraging and aiding the introduction of diversified crops, the improvement of the rural schools, and the construction of substantial highways in the country districts.

There is opportunity for this Department to assist the railroad companies, and through them the agricultural industry, by investigating the relation of transportation to agriculture and advising as to methods that the companies can adopt that will assist farmers in the marketing of their crops and encourage the production of such articles as are best suited to their soils.

#### MISCELLANEOUS WORK.

The Farmers' Institute Specialist visited during the year officially eleven States and delivered 20 prepared lectures, besides a number of informal addresses. In addition to his annual report, he prepared for the printer copy for the following publications: List of State Directors of Farmers' Institutes and Farmers' Institute Lecturers, Legislation Relating to Farmers' Institutes in the United States, Agricultural Instruction for Adults in Continental Countries. He also aided in the editing of the Proceedings of the Tenth Annual Meeting of the American Association of Farmers' Institute Workers and the Course in Cheese Making for Movable Schools of Agriculture.

The list of correspondents has increased until now there are over 14,000 names of individuals with whom correspondence is conducted. These lists are classified according to the interests with which the individuals are severally identified.

#### RECOMMENDATIONS

In order that this Office may be in a position to act efficiently as a central rallying point and clearing house for the movement for the wider diffusion of agricultural education among the masses of our rural population, as it is already acting in the interests of the agricultural colleges, experiment stations, and farmers' institutes, it is necessary that the funds for the maintenance of the Office shall be increased. As the basis for the consideration of what this increase should be I submit the following summary of the lines of educational effort in which it is, in my judgment, desirable for this Office to engage in the immediate future:

(1) To aid the agricultural colleges to reduce the results obtained by the Department of Agriculture and the experiment stations to pedagogical form for use in agricultural colleges and schools of different grades. This work will be done, as heretofore, largely in cooperation with the Association of American Agricultural Colleges and Experiment Stations through its standing committee on agricultural instruction.

(2) To aid the State departments of agriculture and the agricultural colleges and experiment stations in increasing the efficiency of the farmers' institutes and other forms of extension work in agricultural education for the masses of farmers and their wives and children.

(3) To aid the agricultural organizations in the several States in pro-



moting an efficient organization of the rural high schools, consolidated common schools, and other educational agencies best adapted to secure a high state of prosperity and contentment in rural life.

(4) To aid the agricultural colleges and other State educational institutions and officers in preparing and inaugurating training courses for teachers of agriculture in secondary and elementary schools.

(5) To make available to teachers and pupils in schools in both country and city the results of the work of the Department of Agriculture and of the experiment stations which are adapted to instructional purposes in connection with nature study and elementary agriculture, the object being to impress our youth with the dignity, value, and attractiveness of country life and pursuits.

(6) To introduce experimentally new features of agricultural education which may be of value in connection with our educational system. Just now it seems desirable to find out how far a system of movable schools or short courses may be used to supplement the farmers' institutes.

(7) To make a special effort to increase the efficiency of agricultural instruction in the negro land-grant colleges in order that the funds granted for negro education by the Federal Government may contribute toward keeping the negro on the farm and making him a more efficient factor in agricultural production rather than, as is largely the case at present, drawing him away from the farm.

(8) To prepare and distribute suitable charts and other illustrative material on agricultural subjects for use in schools, farmers' institutes, etc.

To enable this Office to perform satisfactory service in these lines at least \$20,000 should, in my judgment, be appropriated for our educational work for the ensuing fiscal year.

#### PUBLICATIONS OF THE OFFICE.

The publications of the Office have not changed materially in character during the year, being, as heretofore, of four main classes: (1) Experiment Station Record, which gives a technical review of the current literature of agricultural investigation throughout the world, and Experiment Station Work, which is published periodically in the Farmers' Bulletin series of the Department and gives a popular summary of some of the more salient practical results of the work of the experiment stations. In this class should also be included the bimonthly list of experiment station publications, which is regularly published by the Office in editions of about 4,000. (2) Publications relating to the food and nutrition of man, consisting of technical and popular bulletins, circulars, etc., reporting or based upon the results of nutrition investigations conducted under the auspices of the Office. (3) Publications relating to irrigation and drainage, which include reports, technical and popular bulletins, circulars, etc., giving the results of the irrigation and drainage investigations of the Office. (4) Miscellaneous publications, including those relating to agricultural education in general, including farmers' institutes, proceedings of the Association of Agricultural Colleges and Experiment Stations, and of the Association of Farmers' Institute Workers, annual reports of the Director and of the Office of Experiment Stations, and similar publications.

The total number and volume of documents issued by the Office during the year has increased, notwithstanding earnest efforts to restrict

publication. The increase has been due mainly to the growth of the work of the insular stations, the development of educational work, and to a larger output of popular (farmers') bulletins summarizing the practical results of the nutrition, irrigation, and drainage investigations of the Office, and of the work of the State agricultural experiment stations in various lines.

During the year the Office published 71 documents, not including revised reprints, separates, etc., aggregating 5,128 pages. These documents include 11 numbers of Experiment Station Record, 14 technical bulletins, 1 bulletin of the Alaska Experiment Station, 5 bulletins of the Hawaii Station, 3 bulletins of the Porto Rico Station, 2 reports, 10 Farmers' Bulletins (including 6 numbers of the subseries Experiment Station Work), 5 circulars, and 5 articles for the Yearbook of the Department. Two other numbers of the Experiment Station Record, 6 technical bulletins, 1 annual report, 1 bulletin each of the Alaska and Hawaii stations, and 2 of the Porto Rico Station, 1 Farmers' Bulletin, 1 circular, and several miscellaneous documents containing about 1,500 pages, were prepared and submitted for publication before the close of the fiscal year. The policy of reprinting separates of individual articles contained in larger reports was continued with satisfactory results. Thirty-three such separates, aggregating 1,269 pages, were reprinted in additions of varying size to meet the actual demands for the articles. Several documents, particularly those relating to the work and expenditures of the State agricultural experiment stations, as well as of those of Alaska, Hawaii, and Porto Rico, were combined, as usual, in the Annual Report of the Office of Experiment Stations, for the printing of which Congress has made special provision.

Several of the earlier technical and farmers' bulletins of the Office were exhausted during the year and were reprinted, in many cases with complete revision or more or less important additions and corrections. Eleven of the earlier numbers of Experiment Station Record were reprinted in limited editions to complete sets.

#### ANNUAL REPORTS.

During the past year the Office issued as usual two annual reports—one, the administrative report of the Director (of 55 pages), giving a summary of the work of the Office during the year for incorporation in the Annual Reports of the Department, and the other, the Annual Report of the Office (of 724 pages), specially authorized by act of Congress. In the latter administrative details are reduced to a minimum, and an attempt is made to show the progress of agricultural research and education in the United States during the period covered by the report by means of a detailed report on the work of this Office and of the several agricultural experiment stations and by articles illustrating progress in nutrition, irrigation, and drainage investigations, in farmers' institutes and agricultural education, and in various special lines of investigation at the experiment stations.

#### EXPERIMENT STATION RECORD.

During the year Volume XVII of the Record has been completed. As usual, the review has included abstracts of the publications of the agricultural experiment stations in the United States, the United States Department of Agriculture, the researches of experiment sta-

tions and similar institutions in all parts of the world, and a large number of articles having a direct bearing upon agricultural science which are published in the scientific journals at home and abroad. It has thoroughly maintained its well-established character of a world review of agricultural experimentation, and it remains the only journal of its kind published under governmental or private auspices. The careful discrimination necessary to the collation of such an abstract journal has been exercised to keep it within the scope and character determined upon and to restrict the review to articles which are worthy of the attention of agricultural experts and scientists.

The appreciation in which Experiment Station Record is held is more manifest each year. It becomes a repository of information which can not be found without very extended and time-consuming research of the literature, and as time goes on the carefully indexed volumes become of increasing value and a practical necessity to men who are looking up subjects of investigation. The inauguration of more advanced investigation under the Adams Act will give the Record an increased value and importance. It enables the workers to follow the progress of experimentation and research in various lines, and makes them more resourceful and useful men for such work.

The limitations of space which are now imposed (12 numbers of 100 pages each) present a great hindrance and drawback in the publication of this review. This is apparent in the promptness with which accounts of the work are issued, the fulness of the abstracts which is possible, and in the completeness of the review. It is impossible at present to prevent abstracts accumulating, and it is often necessary to hold back important abstracts for months before they can be published. The condensation of abstracts has been carried to such a point that there is a widespread demand for fuller accounts of the work. Often the work is published in unusual and out-of-the-way journals which are not accessible to our station workers. Their only knowledge of it must be gained from the Record abstract. Their request for more explicit and detailed abstracts is regarded as entirely reasonable, although it is impracticable with the present space available.

This criticism of the Record is not confined to station men, who, on account of their isolation, have very meager library facilities. Attention is frequently called to the matter by members of the Department staff, who find the Record an aid to them in their research of the literature, and who can not afford the time to read lengthy accounts of foreign investigations in the original language.

There is also call that the scope of the publication should be extended to include more of the work on related lines, such as investigation bearing on the principles of plant breeding, work in agricultural bacteriology, agricultural economics, agricultural education, and the like.

There is great need for an extension of the size of the individual numbers, rather than that more numbers be issued within the year. The limitation which now confines each number strictly within 100 pages causes a great deal of added work in the matter of adjustment, and makes it necessary to withdraw matter which should be published promptly. A quite critical condition has now been reached in spite of every attempt to economize space. The importance and value of the Record to the work of the Department of Agriculture and to the experiment stations, as well as in making such work available to agricultural instructors and State officials, should warrant an extension of



space. A corps of ten editors devoting only a portion of their time to this review are able to economize the time of fully 2,500 Department and experiment station workers, and to make their efforts more effective. Aside from the free distribution, which is carefully restricted, the Superintendent of Documents reports that there were 330 regular subscribers to the Record last year.

#### EXPERIMENT STATION WORK.

Six bulletins of this series were issued at regular bimonthly intervals during the year, first in large editions in the regular Farmers' Bulletin series of the Department, and afterwards in smaller editions (3,500 copies) with consecutive paging, so that they may be bound with index, tables of contents, etc., in convenient form for reference.

This series of bulletins gives popular summaries of some of the more important practical results of experiment station work and attempts to do for the practical farmer what the Experiment Station Record does for the investigator and technical reader. Being published in large editions and widely distributed, they disseminate the practically useful results of experiment station work more thoroughly than can be done by the individual stations themselves through their comparatively limited editions of bulletins and reports, which, moreover, are in many cases restricted to distribution in the particular State in which the station is located. The fact that these bulletins attempt to present careful and conservative summaries of the best available knowledge on a great variety of agricultural topics has led to their being used more and more by the experiment stations and by this Office in answering the numerous inquiries on various subjects which are received. Mr. W. H. Beal has the general editorial management of this series, the articles for which are prepared by the members of the editorial staff of the Experiment Station Record.

#### OTHER PUBLICATIONS OF THE OFFICE.

The other publications of the Office consist chiefly of (1) technical reports, bulletins, and circulars, including those on nutrition (see p. 42), irrigation and drainage (see p. 62), and farmers' institutes and agricultural education (see p. 19), annual reports (see p. 21), and miscellaneous documents; and (2) Farmers' Bulletins, including the series known as Experiment Station Work (see above). The supervision of the editorial work involved in the preparation of these publications for submission to the Division of Publications constitutes the special business of the Editorial Division of this Office, of which Mr. W. H. Beal is chief.

#### CARD INDEX.

Copy for 1,200 cards of the index of experiment station literature was prepared in the Office and forwarded to the Division of Publications during the year. This keeps the index as nearly up to date as has been found practicable. Some of the earlier cards, of which the supply has been nearly exhausted, have been reprinted in order to meet the increasing demand for sets of this index. The number of index cards distributed has reached 26,900. The receipts from sales of the index during the year were \$195.97.

## BIBLIOGRAPHICAL WORK.

The Office continues to cooperate with the Library in the preparation of author and subject indexes in card form to the more important articles in the leading agricultural journals. Summaries of the literature of foreign investigations in veterinary science and experiment station investigations in corn culture were included in the annual report of the Office for 1904. Similar summaries of station investigations on food and nutrition of man, insecticides, and handling and care of milk, are included in the report for 1905. As heretofore, a list of bibliographies relating to agriculture appearing during the year has been prepared for the report of the bibliographer of the Association of American Agricultural Colleges and Experiment Stations. From time to time the Office prepares lists of references along different lines for station workers, which service has been greatly appreciated. Bibliographies of a number of subjects, prepared primarily for Office use, have been added to during the year. The compilation of ash analyses of American farm products, with references to publications from which the analyses were collected, has been completed. Nearly 5,000 analyses have been collected and calculated to a uniform basis, and averages have been computed. The publication of this compilation is delayed until the data and calculations can be carefully verified.

The collection of station publications has been continued as heretofore, and additions have been made to the sets of Department and station publications at the Alaska, Hawaii, and Porto Rico stations. A large number of foreign publications of all kinds have been received as exchanges. Many duplicates of station and other publications were received, a considerable number of which were distributed to college and station libraries and officers.

Considerable progress has been made during the year in completing a set of the books published by agricultural college and experiment station men. The collection now includes nearly 500 volumes.

## SIZE OF EDITIONS AND DISTRIBUTION.

The most important questions concerning the publications of this Office which have arisen during the past year relate to the size of editions and the method of distribution. Considering the great variety of publications issued by the Office, it seems clear that no general rule can well apply to their printing and distribution, and it is doubtful whether they can be so classified as to make it altogether unnecessary to pass on individual documents as they are presented for publication. This applies especially to the technical publications prepared as the result of the special investigations in charge of this Office or for use in the propaganda in the interests of agricultural education. These are intended mainly for the use of teachers, farmers' institute lecturers, and other special classes of persons whom for various reasons the Department desires to interest in its work in order that through them a wider public may become interested in and benefited by the results which the Department is obtaining through the use of public funds. To proceed on the theory that all technical publications of this character should be issued in very limited editions and distributed only by sale through the Superintendent of Documents would in my judgment greatly diminish the usefulness of this Office, and in many ways tend to almost entirely defeat the purposes for which Congress appropriates the

money which is used to obtain the material for these publications. It is my belief that it is wisest for this Office to have authority to keep limited mailing lists of institutions and persons known to be vitally interested in certain lines of its work and to base the initial edition of its technical publications on these lists, as a rule. After free distribution has been made to such a list in the case of any particular document, the requests for further copies should be carefully scrutinized, and whenever a reasonable demand is apparent other limited editions should be printed as may seem best. Experience has shown that in general from 3,000 to 5,000 copies are required for the first editions of the technical publications of this Office, or from 60 to 100 copies for each of our States and Territories. After this, one or two editions of 1,000 copies will usually satisfy any reasonable demand for free distribution.

#### EXHIBITS AT THE PORTLAND AND JAMESTOWN EXPOSITIONS.

The exhibit of this Office at the Lewis and Clark Exposition at Portland, Oreg., as described in my previous report, was maintained until the close of the exposition, in charge of Dr. E. V. Wilcox. The plan of having a representative of the Office continuously in attendance to explain the exhibit to visitors was quite satisfactory, and made the exhibit unusually effective as a means for the dissemination of information regarding our work.

Congress having made an appropriation for a Government exhibit at the Jamestown Tercentennial Exposition to be held in 1907, this Office has been called upon to prepare an exhibit for that exposition, and at the request of the Department representative on the Government board, Doctor Wilcox has been designated as the special agent to represent this Office in the transaction of this business.

#### WORK FOR THE CIVIL SERVICE COMMISSION.

The Director of this Office has continued to act as the general representative of the Department in matters relating to the examination held by the Civil Service Commission for technical and scientific positions in the Department. The number of papers received from the Civil Service Commission recorded in this Office and rated by examiners in the Department during the year was about 1,200, thus equaling the number reported last year. Besides the regular examinations, 62 special examinations were held during the year, as compared with 46 last year.

#### INSULAR STATIONS.

The special agents in charge of the experiment stations in Alaska, Hawaii, and Porto Rico report considerable progress in their investigations for the fiscal year ending June 30, 1906. The lines of work indicated in previous reports have been continued and, in some instances, new investigations have been inaugurated, as is shown in the reports of the individual stations, and attention is called to the suggestions of the special agents for additional facilities for the development of their work. No important changes have been made in the personnel of the different stations, except at the Porto Rico Station, where the vacancy in the position of entomologist and plant pathologist has been filled by the appointment of Mr. W. V. Tower, a graduate of



the Massachusetts Agricultural College, and a postgraduate student of the same institution.

The policy of restricting the work at the several Alaska stations to a few lines seems to be a wise one. For the present at the Sitka Station, horticultural investigations will be the principal lines of work, and they will be supplemented by cooperative experiments elsewhere. The Rampart and Copper Center stations will give their main consideration to the growing of cereals and grasses, while the station at Kenai will be devoted to live stock and dairying. The special appropriation of \$3,000 for the purchase and introduction of live stock was expended for 11 head of Galloway cattle, and they were safely landed at their destination and are reported as being in good condition upon the native grass forage. The real trial of their adaptability will come this winter. Arrangements have been made to provide a considerable supply of grain hay from the station, and with the well-known hardiness of Galloway cattle no trouble in wintering them is anticipated.

Something more than a year ago settlers at and about Fairbanks petitioned the Secretary of Agriculture for the establishment of an experiment station in the valley of the Tanana River. The special agent in charge of the Alaska Experiment Stations visited the region and selected a tract, which was set aside by Presidential proclamation for agricultural purposes. The early equipment of this station is earnestly desired.

The Hawaii Station reports an increasing appreciation of its efforts toward diversifying the agricultural industries of the islands, and as a direct result of three years' experimental work with tobacco it is said that this year a number of field trials were made. The discovery by the chemist that Hawaiian fodders and feeding stuffs are quite deficient in lime is an important one, and will make it possible to arrange more satisfactory rations for stock. Investigations on the marketing of tropical fruits can hardly fail in opening markets on the Pacific coast that can best be supplied from Hawaii. The cooperation of the station has been sought to aid in reestablishing the coffee industry to something like its former importance. Rice investigations, as mentioned elsewhere, have been taken up and a large amount of the funds have been contributed by private individuals. It appears that the former attitude of opposition to the station is giving way as the results of the investigations are becoming better known, and advice and cooperation is sought on many agricultural problems.

The Porto Rico Station is extending its influence and requests for cooperation are coming from numerous sources. While the income of the station has not been sufficient to enter into all these plans, yet this growing sentiment in favor of the station is very encouraging. The coffee experiments have begun to show results, and the improved methods of pruning and cultivation are quite apparent in the increased yields obtained. Demonstration experiments are planned for several important coffee centers to show the beneficial results that have been obtained in experiments at the coffee substation.

The income of the several stations from the Federal Treasury for the past year was \$15,000, and this was augmented by sales funds which, by act of Congress, are available for station purposes. The sales funds for the fiscal year 1906 were as follows: Alaska, \$350.70; Hawaii, \$625.99, and Porto Rico, \$1,164.52. The constantly growing demands on these stations for the extension of their work and the

fact that not only current expenses but also buildings and other permanent equipment must be provided for from the Federal funds, make it seem only fair that the outlying stations should have the same increase of appropriations as has recently been made by Congress for the agricultural experiment stations in the United States generally. As this can only be done by special appropriations, I recommend that \$24,000 be asked for each of the stations in Alaska, Hawaii, and Porto Rico in the estimates for this Office for the next fiscal year.

Cooperative work has been carried on between the different stations and this Department, and a special acknowledgment is made of the generosity of the Bureau of Plant Industry in furnishing large quantities of seed for station use as well as for general distribution to settlers in Alaska, and for tropical economic plants for the Hawaii and Porto Rico stations.

The work of the Washington office in connection with the insular stations has greatly increased during the past year. This business has, as hitherto, been in charge of Dr. Walter H. Evans, as chief of the Division of Insular Stations. During the year the special agents in charge of the Alaska and Hawaii stations have spent some time in Washington.

#### ALASKA EXPERIMENT STATIONS.

During the summer of 1905 the weather along the coast region of Alaska was generally favorable to agricultural operations, and gardens in that region were quite uniformly successful. In different parts of the interior the conditions were far from uniform. In general the spring was late and cool and the early growth of plants was slow. In the Yukon and Tanana valleys there was too much rain and too little sunshine, while in the Copper River Valley there was not enough rain, and killing frosts occurred as early as August 14. Slight frosts were reported in the Yukon Valley late in August, but killing frosts did not come until the middle of September. As a result of these conditions, grain crops matured at the Rampart Station, while only limited amounts of cereals were matured at the Copper Center Station, more than 300 miles farther south.

The special agent in charge of the investigations visited the stations during the past year and reports satisfactory progress at all. While in the interior he paid a visit to the valley of the Tanana to investigate the agricultural possibilities of this country, which is rapidly attracting miners and others, especially in the region about Fairbanks. After a careful inspection of this country a tract of about 1,400 acres was surveyed for a future station site and by Executive proclamation dated March 22, 1906, it was set aside for that purpose. This tract lies at the junction of two railroads that run to important mines and is about 4 miles from Fairbanks and Chena, both prosperous towns on the Tanana River. In the region contiguous to these points there are estimated to be from 10,000 to 15,000 people, and in recognition of their future needs a station is contemplated. Nothing can be done at present in developing this tract, but with an increased appropriation the work should be begun and pushed as rapidly as possible. Based upon his personal observations and upon the experience of numerous settlers, the special agent believes that the Tanana River is well adapted to agriculture as it is understood in Alaska.

The special appropriation of \$3,000 made by Congress for the purchase and introduction of live stock has been expended in securing 11 head of cattle and 2 horses. The cattle were all of the Galloway breed, and they have been divided between the station at Kenai and at Wood Island, where they were placed temporarily in the charge of Mr. C. P. Coe, who has been cooperating with the stations for a number of years. The cattle were shipped from Seattle during the spring of 1906, and in August were reported as being in fine condition. They had received no feed but the native grasses upon which they grazed. With the appropriation for this year it is hoped to extend the investigations with animals, and, if possible, to include some hardy race of sheep.

**SITKA STATION.**—As reported last year, it has been decided to devote most of the investigations at the Sitka Station to horticulture, and these will be conducted along the lines of the introduction, propagation, and testing of fruit trees and shrubs, and to the testing of varieties of vegetables, to ascertain the kinds best adapted to the soils and climate of the country. The nursery stock made growth during the season that was considered on the whole satisfactory. Of a large number of varieties introduced, several have been selected as quite promising, and they will be extensively propagated and given as wide a trial as possible. Experiments were being continued in the domestication of native varieties of raspberries, strawberries, etc., and breeding experiments are being carried on to develop forms especially adapted to Alaskan conditions. During the past season attention has been especially given to the testing of varieties of potatoes, cabbage, and cauliflower. About 30 varieties of each have been planted, and it has been found necessary to continue these experiments for a number of years, in order to determine what is the best to recommend for Alaska.

Attention has been called in past reports to the acid nature of the soils, and the special agent has devised a method for the production of lime in small quantities which is readily adapted to use wherever limestone is available. By the liberal use of lime the soils in many places may be speedily rendered fertile, but hitherto the high cost of the lime has precluded its extensive use.

In continuation with the policy established several years ago, the station has cooperated with settlers in vegetable growing in all parts of the Territory. These experiments are made possible through the generous cooperation of the Bureau of Plant Industry of this Department by supplying seeds of all kinds. By this means tests are made of varieties of vegetables in many remote regions and reports of success or failure with them are received from the cooperators. There are hundreds of gardens planted every year in Alaska that are wholly dependent upon this source of supply for seeds, as in many regions the stores do not have seeds for sale, and the cooperation of the Bureau of Plant Industry is heartily acknowledged by those in charge of the stations. Cordial cooperation with the Bureau of Soils, Bureau of Chemistry, and Bureau of Entomology is also acknowledged.

The special agent continues to collect meteorological data from a number of stations established through the cooperation of the Weather Bureau of this Department, and from the monthly reports is accumulating a mass of data upon which to base a summary of the climate of Alaska.



**COPPER CENTER STATION.**—The work of this station is devoted chiefly to grain growing, and about 40 acres of land have been cleared. This tract has been divided into about 200 plats, most of which are devoted to growing cereals and grasses. As in the previous years, most of the cereals were destroyed by frost, yet two varieties of wheat, one of rye, three of barley, and seven of oats matured part of their crop. The grain matured has been saved and will be seeded for future observation in the hope that earlier and more hardy varieties may be secured. The station has but one team of horses and is unable to secure enough labor to get the crops in the ground early enough in the spring, so that late seeded crops are liable to suffer from frost. One point that has been developed since the establishment of the station is that the rainfall in this valley is very light and is probably not enough for the normal development of crops. The rainfall from October, 1904, to September, 1905, was but 9.8 inches, and of this only 3.05 inches fell during the growing season. It seems probable that some irrigation will be necessary in this region. In connection with the experiments at this place, fall plowing has been found essential for crop production and will thus apply generally to the interior of Alaska, as it reduces very materially the spring work and enables the crops to be sown earlier in the season.

**RAMPART STATION.**—At this station there was no regular superintendent for a number of years, and but little work of a permanent character was undertaken. Mr. F. E. Rader, formerly connected with the Sitka Station, was transferred to Rampart in July, 1904, and has since been in charge at that place. There are now  $5\frac{1}{2}$  acres cleared and ready for the plow, and last season about  $2\frac{1}{2}$  acres were in cultivation. Although the season was reported as unfavorable, owing to the unusual amount of rain and cloudy weather early in the summer, spring-sown grains all matured. Fall-sown grains were winterkilled to a large extent on account of a light snowfall, although a variety of winter rye came through and ripened satisfactorily. Vegetables of all hardy kinds were successfully grown.

Arrangements were made whereby the station secured at a low price a considerable quantity of lumber, and it will now be possible to construct some much needed buildings. This station is in need of a considerable increase in its equipment. More implements should be provided and a team of horses is needed if the work is to be extended.

**KENAI STATION.**—As announced in last year's report, the Kenai Station will be largely devoted to live stock and dairying. There are about 25 acres under cultivation, most of which is in grass or has been sown with oats for grain hay. In addition to the small herd of native cattle there have been added a number of the Galloway cattle referred to elsewhere in this report, and it is hoped to increase this herd by subsequent purchases. At present there are 17 head of cattle at this station and all are reported as in a thriving condition. A small dairy equipment has been added to the working outfit of the Kenai Station, and butter and cheese of good quality are being regularly produced that find a ready market. A few years should demonstrate the profitability of dairying in the southeast portion of Alaska.

#### HAWAII EXPERIMENT STATION.

The work of the Hawaii Experiment Station has been continued along the same general lines described in previous reports. The

special agent, in addition to his administrative duties, has had the direction of experiments with grasses and other forage plants, tobacco cultivation, investigations with coffee, cassava, rubber, tan-bark production, etc. The experimental work with tobacco that has been in progress for three years at Hamakua was attended with such marked success that arrangements have been made for growing it on a field scale. In addition to growing the crop, drying and curing sheds have been erected and attempts will be made in preparing tobacco for market. The work with tobacco last year was a preeminent success. Considerable quantities of leaf tobacco were produced, cured, and manufactured under the direction of the special agent in charge. Seed of all the leading types of cigar tobaccos were obtained and a crop of Sumatra grown which gave fully 20 per cent of its leaves of excellent texture, and were valued by an expert tobacconist as worth from \$2 to \$4.50 per pound for cigar wrappers. The remainder of the crop was nearly all adapted to use as filler. The tobaccos of the Cuban type were of excellent character, a fair proportion suitable as wrappers, and the filler was worth from 15 to 50 cents per pound. When the yield per acre and the proportion of high-grade tobacco were considered, the possibilities of profitableness of this new Hawaiian industry seems assured.

The attention of the tropical world has been recently turned to rubber cultivation. The greatly increased demand for this product has resulted in a rapid diminution of the available supply, with an increase in price. In common with many experiment stations in tropical countries, the Hawaii Experiment Station is experimenting with various kinds of rubber-producing plants with a view to ascertaining their relative worth under Hawaiian conditions. A considerable planting has been made on the slopes of the upper part of the station grounds, and the special agent has supervision of an experiment on the island of Maui in the cultivation of rubber and the fertilizer requirements of the trees. Data are being collected regarding many species of rubber-yielding plants which are represented by specimen trees on various parts of the island. Rubber cultivation is a relatively new industry, and many important questions are to be answered regarding varieties, culture, harvesting, etc., and the Hawaii Station hopes to aid in their solution.

Attempts are being made to restore the coffee industry to something like its former importance. The low prices of the South American and Central American coffees has depressed the market to such an extent that under the usual conditions it is no longer possible for Hawaii to compete in the general markets. Efforts are now being made to create a special market for Hawaiian coffees which is based on the superior character of the product of the Hawaiian plantations. The special agent has devoted much of his time to the consideration of the coffee problems, and is assisting in experiments relating to cultivation, topping, shading, curing, and marketing, as well as the diseases and insect pests of coffee, and he expects to prepare a bulletin treating of these various topics.

Arrangements have been made and work begun with a view to rehabilitating the rice industry of the island. These investigations will include everything pertaining to rice cultivation. Under the present system of high land rent, and the primitive Chinese methods of cultivation, rice can no longer be grown at a profit, and studies will

be made on the use of improved machinery, fertilizers, the testing of varieties and breeding of new varieties, the use of water, etc. Through the Bureau of Plant Industry of this Department about 150 varieties of rice were obtained for testing, and it is believed among them some of superior merit will be found. To carry on this work Mr. F. G. Krauss, for several years agriculturist at the Kamehameha schools, has been appointed. The use of land for the experiments has been donated and other assistance provided by various citizens.

The entomologist is continuing his investigations along economic lines. His studies on the mango weevil are being continued, and experiments for its control are in progress. This pest, which was first reported by the entomologist of the station, seems to be spreading, and large numbers of seed are annually destroyed. The weevil spends most of its life in the seed, hence its control will be difficult. Investigations are also being pursued on forest insects, those attacking coffee, citrus fruits, etc., and data are being collected for a report on the principal insect pests of Hawaii.

The experiments begun last year with bees and silkworms have been continued with satisfactory results, and it is believed that these home industries can be made profitable.

The entomologist continues to act in connection with the committee having charge of the campaign for the elimination of mosquitoes, and largely through his efforts an experiment with top minnows for the destruction of mosquito larvæ was undertaken. A supply of these minnows was obtained in Texas, transported to Honolulu, and has since been liberated in fish ponds, taro patches, rice fields, etc., where they are reported as increasing rapidly. These minnows feed quite extensively on mosquito larvæ, and by their introduction it is possible to treat extensive breeding places that could not otherwise be cleared.

The chemist, in addition to the routine work that comes to a chemical laboratory connected with an experiment station, has made quite a study of the composition of some of the Hawaiian-grown fodders and feeding stuffs. While this study is not complete, it has been carried far enough to show a decided deficiency in the lime content of Hawaiian forage. The results of the investigation, so far as completed, have been published in a bulletin of the station and attention called to the lack of lime and some of its possible consequences.

In research work the chemist has continued his studies on the nitrogen content of Hawaiian soils, paying especial attention to the pyridin compounds, which he has shown are present in considerable quantities.

In connection with the shipping of fruit, canning of pineapples, sugar making, etc., there is now a very large percentage of waste products that seem to offer possibilities of utilization, and the chemist is investigating some of these problems. He is also studying the nature of the fats and carbohydrates in some common Hawaiian plant products. Considerable attention is also being given to poisonous principles in the seed, tubers, and other parts of a number of plants of economic importance, among them sorghum, cassava, and arrow root, and he is also studying the latex of a number of rubber-producing plants.

Experiments are being carried on with the cooperation of the entomologist in studying Hawaiian honeys, and a series of investigations have been begun on the manganese content of Hawaiian soils. In



some parts of the islands manganese occurs in large quantities and studies will be carried on to determine the effect of this substance on plant growth.

The horticulturist has extended the collection of economic plants, and reports progress with the banana and cacao investigations in cooperation with the Hilo school. The collection at the station of local varieties of bananas, avocados, mangoes, citrus fruits, and other economic plants is being continued, and with the installation of the new water system it will be possible to collect these more rapidly than in the past. In addition to seedlings and local varieties, much assistance has been given by the Bureau of Plant Industry of this Department in securing improved varieties of mangoes, cacao, etc. A trial shipment by mail was made of cacao plants between this city and Honolulu, and the plants were received in fairly good condition, quickly recovered from the effects of the shipment, and are now growing finely. These plants were nearly three weeks on the way from Washington, D. C., to Honolulu, yet their present condition is all that could be desired.

A bulletin on the mango in Hawaii was issued, in which all available data regarding cultivation, marketing, varieties, fungus and insect pests, etc., were given. In this publication descriptions were placed on record of 34 varieties of mangoes, many of which had never before been accurately described. In addition a number of recently introduced varieties were included.

Especial attention has been given the marketing of tropical fruits, and experiments are in progress to test various methods of handling, packing, and temperature for storage, and a large experimental shipment of such tropical fruits as pineapples, bananas, avocados, papayas, etc., was accompanied to San Francisco in order to study the conditions on shipboard, at the wharves at San Francisco, and the reshipment to other markets. This investigation is considered of great importance, as little attention has been given to the marketing of such products, and with the possible extension of horticulture in the islands an outlet for the surplus must be provided.

An experimental planting of several hundred varieties of grapes has been made at Makawao, on the island of Maui. With the considerable Portuguese population already in the islands and a prospect for more, it is believed that the growing of grapes and wine making will offer considerable opportunity for home industries.

#### PORTO RICO EXPERIMENT STATION.

No important changes have been made in the lines of work at the Porto Rico Station. As formerly, the principal investigations have been with agricultural and horticultural crops, their insect and fungus pests, and along various lines of animal husbandry. Attention is being paid as opportunity offers to a study of some of the problems connected with the use of fertilizers, soils, drainage, etc. The vacancy in the staff reported last year has been filled by the appointment of Mr. W. V. Tower, of the Massachusetts Agricultural College, as entomologist and plant pathologist, and he entered upon his duties early in May. The station has need of a chemist, and one should be provided and a laboratory equipped as soon as the resources of the station will admit. There are many problems relating to the chemistry of soils, fertilizers,

crops, fruits, etc., that are very important, and the station should be equipped for this work.

The insular government has again failed to grant direct financial assistance to the station, but there are cooperative experiments in progress between the station and the insular government in stock raising and in fiber production. The latter is confined almost wholly to the growing of sisal, the local government providing funds for carrying on the experiment. The relations with the insular government are friendly, but a lack of revenue has made it impracticable to secure a direct appropriation from the legislature.

In addition to his administrative duties, the special agent in charge is giving his attention to various field crops and to animal husbandry. Of the former, corn, cotton, rice, tobacco, potatoes, and forage plants are given prominent consideration. The varieties of corn introduced from the States have not proved satisfactory in his experiments and attempts are being made to breed up the native varieties to a greater production. Sea Island cotton has been found to do well in certain sections, but the area adapted to its culture will probably not be greatly increased, as often the same lands are also adapted to cane growing and are more profitable for that purpose. A successful effort is being made to grow lowland rice, and this industry should be greatly extended. The Porto Ricans are large consumers of rice, the most of which is imported, and the small percentage grown on the islands is of the upland type and is found only in small areas in the interior of the island. Tobaccos other than cigar types are being cultivated and the White Burley has done well on the station grounds. It may be possible to considerably extend the tobacco area of the island by the introduction of new types. Experiments carried on at the station during the past winter showed the possibility of growing potatoes, and both the yield and quality were satisfactory. The experiments show that under proper conditions potato growing for local and northern markets can be made a commercial success. Among the forage plants experimented with cowpeas are most successful and are recommended for all localities. Some experiments with alfalfa on well-drained soil are very promising, and it is believed under proper conditions alfalfa will prove a valuable addition to the forage crops of the island.

The station acquired, a year or more ago, a saddle-bred stallion, some pigs and chickens, and has had charge of a number of head of cattle imported for breeding purposes. Late this summer the stallion died as a result of a serious accident, coupled with an attack of distemper, which was epidemic at the same time. In connection with the experiments with cattle, a number of head have been under observation for some time, and the special agent reports that while the animals are infested with ticks there has been no indication of Texas or tick fever. Similar testimony comes from other parts of the island, seeming to show that animals imported from the mainland north of the quarantine line have not shown any indication of disease, although the ticks are very abundant. Experiments made some years ago by the Bureau of Animal Industry of this Department indicated that ticks received from Porto Rico were capable of producing the disease on animals at the experiment station near Washington. In view of this fact and the apparently contradictory testimony relating to the impor-

tation of animals into Porto Rico, a full inquiry by a competent investigator is desired. The live-stock industry of Porto Rico ranks high in money value, and it should be safeguarded by such an investigation and a quarantine against importations, if that should be found necessary.

The experimental work in horticulture continues to occupy an important place. The station grows a variety of plants, and has also an orchard comprising about 25 acres, in which are now growing about 100 species of fruit trees. Plantings of citrus trees, cacao, mangoes, and other economic plants have been continued, and experiments on their cultivation and fertilizer requirements are in progress. Especial attention is being given to pineapple culture and shipment. A number of trial shipments have been made between the station and New York and between the station and Washington, D. C., the principal object being to test the shipping qualities and also the methods of packing. Of the shipments to this city, most of the fruits came through in good condition, and some of them were kept for a week or ten days in an office room during a period of great heat and humidity without deterioration. Experiments are also being carried on in testing varieties, and some of exceptional merit have been obtained. These will be tested further and propagated and disseminated as fast as opportunity offers. The nursery plantings of citrus fruits, avocados, mangoes, rubber trees, etc., are, in general, in a satisfactory condition. Especial attention has been paid during the past year to vegetable growing, and a bulletin has been issued giving results of the investigations. Six plantings at intervals of about two months were made during the year, and it was found possible, with fresh seed and proper cultural methods, to grow nearly every kind of vegetable that is produced in temperate climates. It is believed that all kinds of vegetables may be produced for local consumption as well as for shipment when market conditions will warrant. With vegetables, as well as with all other crops, it will be found that a liberal use of fertilizers will be necessary for abundant production. Data are still being collected concerning a large number of tropical plants at the station.

The experiments at the coffee substation have been continued, and a number of introduced varieties have seeded, offering a means of comparison with the standard Porto Rican commercial variety. The cultural experiments are beginning to give results, and the beneficial effects of pruning, cultivation, and the use of fertilizers are plainly shown. Some of the trees that are just coming into bearing have produced more than double the crop grown on trees in the regular plantation without cultivation. At the coffee substation some attention is being given to the introduction of other economic plants that may prove useful to coffee growers. Alfalfa, cowpeas, and other leguminous plants have been grown to test their value as sources of nitrogen when introduced into the coffee plantation. As demonstration work is of special value among the people of Porto Rico, it is planned to carry on a series of cooperative experiments in coffee culture in different coffee centers of the islands, so that the results obtained at the La Carmelita Station may be widely shown.

The entomologist and plant pathologist is devoting particular attention to combating the pests of citrus fruits. The experiments are being carried on to determine the value of various insecticides and fungicides, and the strengths required for the destruction of the pests without injury to the trees. A number of scale insects are at present the most



threatening enemies of citrus-fruit growing, and these are receiving especial attention. In a similar way attention will be given, as opportunity offers, to the pests of other crops, such as coffee, sugar cane, cacao, etc. The collection of museum specimens of economic plants, fungi, and insects is being continued.

#### NUTRITION INVESTIGATIONS.

During the fiscal year 1905-6 the same general policies as heretofore have been followed with the investigations on the food and nutrition of man conducted under the auspices of the Office of Experiment Stations. Since the nutrition investigations were first instituted the Department has been associated in the work with agricultural experiment stations, agricultural colleges, universities, and other educational institutions, as well as philanthropic associations, hospitals, and institutions for charity and correction in nineteen States and three Territories. By this cooperation the Department funds have been materially supplemented in various ways and the scope and possibilities of the work greatly increased.

New experiments have been undertaken whenever the completion of any line of work has rendered this possible, and it has been the purpose to select for study especially those problems which have a direct bearing upon agriculture.

#### OBJECT AND NATURE OF THE INVESTIGATIONS.

The most intelligent use of the cereals, fruits, vegetables, dairy produce, meat products, and other foods produced on the farm necessitates a knowledge of the nutritive value of these materials and ways of handling, preparing, and combining them to form a well-balanced diet. It is also desirable to know the kind and amount of food materials needed by man in order that he may be an efficient worker, and the relation of food to health and well-being. It is the purpose of the nutrition investigations to obtain data which will insure for both producer and consumer the best utilization of the agricultural products of animal and vegetable origin which are grouped under the term "food." Many of the questions which arise in this connection have already been answered, others are being studied, and many remain for future investigators.

As examples of completed studies may be cited investigations which have shown the relative value of different kinds of wheat flour, the high nutritive value of all such foods, and the value of cereal breakfast foods as compared with flour. There are also studies of the relative value of meat cooked in different ways, the determination of the factors which influence flavor and quality of roast meat, the demonstration of the importance of fruits and nuts as sources of nutritive material when intelligently used, and the proof that cheese is thoroughly digestible and a food material of reasonable cost which may be used in large quantities in the diet as an inexpensive source of both protein and energy.

Of problems now under investigation the following may be cited: Studies regarding the comparative digestibility and food value of corn meal of different sorts and other corn products; the value of flour prepared in other forms than bread; the comparative digestibility of meats cooked by other methods than boiling or roasting; the impor-

tance of the mineral constituents of the diet and the amount of each required, and further study of the actual food requirements of men under different circumstances and performing different kinds and amounts of work.

Of problems which remain for future study may be mentioned the relative ease of digestion of different food materials prepared in a variety of ways; the value and relative importance of root crops and green vegetables; the comparative food value of butter, olive oil, lard, and other common food fats; the relation of methods of rearing and fattening farm animals of different breeds and classes to the table quality and food value of meat, and studies of ways in which foods may be used to secure the greatest efficiency of the body for work of all kinds and for the maintenance of health and vigor.

The information needed for the solution of nutrition problems is furnished in large part by dietary studies undertaken to show the relative amount of cereals, meats, dairy products, etc., consumed by persons and groups living under different conditions; by digestion experiments to show how thoroughly the body utilizes different foods; by special studies of the changes brought about in foods by cooking and the effect of heat and other methods of preparation upon nutritive value and digestibility, and by experiments on the metabolism of one or more food elements, as well as by investigations with the respiration calorimeter, an instrument which affords the most satisfactory method yet devised of studying many of the complex questions which are concerned with the way the body uses its food supply and the relative nutritive value of different foods.

#### WORK AT THE WASHINGTON OFFICE.

Besides the general supervision of the plans and expenditures for nutrition investigations, the Office at Washington has performed specific duties in connection with these investigations. Dr. C. F. Langworthy, as expert in nutrition, has had charge of the work.

Data have been collected at the request of Members of Congress and of different branches of the General Government. Teachers, students, physicians, and the general public make large demands for information on various topics concerned with the relative values of different foods and related questions, and, so far as possible, information has been supplied by distributing publications and by correspondence. As heretofore, attention has been paid to the collection of bibliographical and other data relating to food, to the editing of reports of investigations, to the preparation of abstracts of current literature for the Experiment Station Record, and to the preparation of popular summaries of the nutrition work carried on at the experiment stations, for publication in the series of Farmers' Bulletins entitled Experiment Station Work. Requests are frequently received from schools, learned societies, etc., for lectures or informal talks on different topics connected with the general subject of nutrition, and, so far as possible, these requests have been complied with.

Under the immediate supervision of this Office a Farmers' Bulletin, based on experimental and practical studies, was prepared by Miss Maria Parloa on the cooking of vegetables. In a similar way investigations have been conducted by Miss Hyams, of the Massachusetts Institute of Technology, on household methods of canning vegetables,

with a view to the preparation of a Farmers' Bulletin on the subject. Additional studies for the same purpose are being made by Miss Bragg, professor of chemistry at Wellesley College. A Yearbook article on Fruit and its Uses as Food was prepared by Doctor Langworthy, as well as a report on the condition of nutrition investigations, etc.

Arrangements have also been made for the preparation of a Farmers' Bulletin by Mrs. Mary H. Abel on Household Methods of Handling and Storing Food. The bulletin is to include the results of experiments and original research, as well as a summary of available data on the subject.

Studies were undertaken by Doctor Langworthy and H. L. Knight, in cooperation with charitable organizations in Baltimore, of the kind and amounts of food consumed in institutions for aged persons and for children, with the view of obtaining factors for use in determining the relative amounts of food required by the aged and the young.

Special attention has also been paid to collecting data on the pedagogics of nutrition and to systemizing available information in such form that it will be more available for the courses of instruction which are given at many agricultural colleges and other institutions. A summary has been prepared by Miss Sheppard, of the North Dakota Agricultural College, on the ways in which the results of the investigations carried on by the Department of Agriculture are used by teachers of home economics.

#### COOPERATING INSTITUTIONS AND INVESTIGATORS.

The institutions at which the investigations have been conducted during the fiscal year and the investigators were as follows:

*California:* University of California, Prof. M. E. Jaffa and associates.

*Connecticut:* Wesleyan University, Prof. F. G. Benedict and associates.

*Hawaiian Islands:* Hawaii Agricultural Experiment Station, Prof. Edmund C. Shorey.

*Illinois:* University of Illinois, Prof. H. S. Grindley and associates.

*Maine:* University of Maine, Prof. C. D. Woods and associates.

*Maryland:* Baltimore Board of Charities and charitable institutions, Dr. C. F. Langworthy and H. L. Knight.

*Minnesota:* University of Minnesota, Prof. Harry Snyder and associates.

*New York:* Columbia University, Dr. H. C. Sherman; Teachers' College, Miss Helen Kinne.

*Tennessee:* University of Tennessee, Prof. C. E. Wait and associates.

#### THE COOPERATIVE INVESTIGATIONS.

Summary statements regarding the cooperative investigations carried on during the year follow.

#### CALIFORNIA.

The digestibility and nutritive value of different fruits and nuts, important as foods or as commercial crops, have been studied by Prof. M. E. Jaffa and associates, at the University of California, in continuation of the work of former years. In these investigations the fruits and nuts and their products have constituted an integral part of a simple mixt diet, and special attention has been paid to determining the proportion of nutrients which may be supplied by these foods and the thoroughness with which the body can utilize them. Until the investigations were undertaken in California little accurate



information was available regarding the digestibility of these food materials and their relative importance as compared with other foods.

Professor Jaffa has conducted 25 experiments during the past year, which have included studies on the digestibility of fruit and fruit products, as well as the balance of income and outgo of nitrogen.

The importance of the fruit and nut industry in California and the great variety of such products obtainable in the section make the University of California a particularly favorable place for these investigations. Professor Jaffa has been particularly fortunate in obtaining for his experiments subjects who have been used to fruit and nut diet for a long time. For purposes of comparison, persons have also been included who have not habitually used such products in large quantities.

The California investigations have shown that fruits and fruit products may readily supply a considerable proportion of the total energy of the diet and that nuts may be used as a reasonable source of both protein and energy when desirable.

#### CONNECTICUT.

The investigations carried on at Wesleyan University, Middletown, Conn., by Prof. F. G. Benedict and his associates have had to do with the digestibility and food value of green curd and cheese (American Cheddar) made with different amounts of rennet and cured for different lengths of time, the ease and rapidity of digestion of cheese, and the value of this food as a source of energy. In the latter work the respiration calorimeter was used, as was also the case in studies of the normal output of carbon dioxide and the heat output and the oxygen intake of the body under a variety of conditions. As usual, attention has been paid to experimental methods. The cheese investigations constitute the most elaborate and thorough series of studies on the nutritive value of this important dairy product ever conducted under scientific control.

The Dairy Division of the Bureau of Animal Industry has cooperated in the experiments on the nutritive value of cheese, having furnished the samples of cheese used and rendered material assistance in other ways. Quantities of cheese varying from 150 to 200 grams per man per day have been used, with a basal ration of bread and fruit. A total of 184 digestion experiments, each covering four days, were made, special attention being paid to the digestibility of protein and fat and the availability of energy of cheese. From the large amount of data accumulated, it is evident that the cheese was readily digested by the subjects, who were young men in normal health, and neither constipation nor other digestive disturbances commonly attributed to cheese were observed. All the cheese used was of excellent quality, and no differences were noted in the thoroughness of digestion of the different samples.

The experiments with the respiration calorimeter on the thoroughness of digestion and the value of cheese as a source of energy for production of muscular work indicate that the energy of cheese is readily available for work and that this food does not differ materially from other common food materials in ease of digestion.

In general, these investigations have shown that cheese in liberal amounts can be consumed by healthy individuals with no discomfort,

and that this food material, which is reasonable in price, may be used to supply a large proportion of the protein of the diet when desirable.

The great importance of cheese as a source of protein has not been appreciated hitherto, and in a sense its commercial value as a food has lacked a scientific basis. A knowledge of the results of these investigations should therefore benefit the consumer by giving him definite assurance that cheese affords an economical and efficient supply of protein. Under existing conditions an increased demand for this agricultural product is to be expected as the result of such information.

A technical bulletin has been prepared which describes the improvements recently made in the respiration calorimeter, particularly the devices for the direct determination of oxygen, and reports the results of 11 experiments on the metabolism of matter and energy.

Editorial work has been carried on at Middletown by R. D. Milner, as heretofore. Manuscript reports received from collaborators have been prepared for publication, and data have been collected, summarized, and used in the preparation of articles relating to food and nutrition of man, and in other ways. A summary was also prepared for the report of this Office for 1905 showing the character and results of nutrition investigations carried on at the agricultural experiment stations, but independent of cooperation with the Department of Agriculture.

#### HAWAIIAN ISLANDS.

Prof. Edmund C. Shorey, at the Hawaii Agricultural Experiment Station, has continued his studies of the nutritive value of native food products and the kinds and amounts of food consumed by natives and other residents of Hawaii. Comparatively few investigators have directed their attention to the study of the nutritive value of tropical food products and the food requirements of residents in hot countries and related questions, and the results of Professor Shorey's investigations therefore have especial interest, particularly in view of the fact that the United States has such important interests in tropical countries and must necessarily pay attention to questions relating to food and dietetics while so many soldiers, sailors, engineers, and laborers are employed in our island possessions and Panama.

#### ILLINOIS.

Prof. H. S. Grindley and his associates have carried on 35 experiments on the changes in the nutritive value and the flavor, color, and texture when meat is cooked and the possibilities of regulating conditions so that roast meat of uniform character may be obtained. This work has necessitated a study of the character of the extractives and other constituents of the cooked and raw meat and of the bodies which produce the characteristic flavor of cooked meat.

The investigations have shown the way in which thoroughness of cooking and in large degree the quality of the cooked product depend upon the initial temperature of the oven and the length of the cooking period, factors which may be readily controlled.

The investigations have also shown that after meat is removed from the oven the temperature of the interior of the roast continues to rise for a time, owing to the passage of heat from the outer layer to the

interior of the uncut roast. In other words, cooking continues after meat is removed from the oven.

Following the deductions from the experiments, it is possible to cook meat to any desired degree from very rare to very well done and have the results the same from time to time, and the methods outlined can readily be used in the household.

When meat is roasted some loss in weight is sustained, owing principally to the evaporation of water and the removal of fat, which melts and runs out into the pan.

The flavor of roast meat is largely due to the browning of the meat extractives.

#### MAINE.

At the University of Maine and the Maine Agricultural Experiment Station Director Charles D. Woods and L. H. Merrill have studied the digestibility of corn-meal bread prepared in different ways, when used in large quantities and also in moderate amounts, as part of a mixed diet, and have paid special attention to determining the kind and quantity of the metabolic products in the feces. The different sorts of corn bread were especially made for the experiments and all precautions were taken to insure accuracy. The corn bread has been compared with white bread made from standard patent flour, and 27 digestion experiments have been conducted with healthy young men, each experiment being of six days' duration.

The investigations have shown that corn bread of different sorts has fairly high coefficients of digestibility, the average values being about the same as those obtained with graham bread, but, like the coarsely ground wheat-flour bread, it is somewhat less thoroughly digested than standard patent-flour bread.

As a whole, the investigations have demonstrated the high food value and comparatively high digestibility of corn-meal breads and have shown that such foods are valuable in the diet as relatively inexpensive sources of nutrients, as well as for the pleasing variety which their use makes possible.

Professor Woods and Prof. Harry Snyder, of the University of Minnesota, on the basis of investigations which they have carried on in past years with cereal breakfast foods, have prepared a Farmers' Bulletin, which was published early in the year, summarizing available data regarding the digestibility and nutritive value of this class of foods, their place in the diet, and related topics.

#### MINNESOTA.

At the University of Minnesota Prof. Harry Snyder has studied the digestibility and nutritive value of flour prepared for the table in other forms than bread, mainly as crackers or biscuits, pancakes, baking-powder biscuits, and sweet cookies. The special foods have constituted an integral part of a simple mixed diet, and the experiments have been made with healthy young men as subjects. The results obtained have been compared with the results of a large number of similar experiments in which bread of different sorts was used.

The experiments show that on an average the various flour products studied differ little as regards the thoroughness with which they are digested and on an average have practically the same coefficients of



digestibility as bread made from standard patent flour. In other words, the pancakes, crackers, biscuits, and cookies had practically the same value in the diet as white bread when considered as sources of nutrients and energy. In these investigations the question of relative ease of digestibility and related topics have not as yet been considered.

## NEW YORK.

The principal features of the work on the ash constituents of food carried on at Columbia University by Prof. H. C. Sherman and his associates have been metabolism experiments in which the income and outgo of iron, calcium, magnesium, and phosphorus were especially studied; dietary studies, with special reference to iron and the possibilities of increasing the iron content of the diet when necessary without the use of expensive foods and estimations of the amounts of iron furnished in typical dietaries. This work has necessitated the determination of iron in a number of food materials by improved methods and a careful review of the literature of the subject. A bulletin reporting the work has been prepared for publication.

At Teachers' College, Columbia University, under the supervision of Miss Helen Kinne, Miss Stimson has made a study of the culinary qualities of old-fashioned and new-process corn meal, and data have been summarized on the nutritive value and uses of corn meal and other corn products.

The investigations indicate that in order to obtain the same results as regards texture and flavor with the new-process corn meal as with the old, the meal must be cooked for a considerable time with hot water before it is used for bread making and similar purposes.

## TENNESSEE.

Owing to a pressure of other work, Prof. C. E. Wait, of the University of Tennessee, could not conduct the proposed studies of the kinds and amounts of food used in public institutions in and near Knoxville. Considerable attention has been devoted, however, to compiling and editing the results of investigations which have been carried on in the past years and not yet published. As a result two bulletins have been prepared, one reporting the results of extended series of experiments on the digestibility of dried legumes (peas, beans, and cowpeas) and the other the results of dietary studies of families living in the mountain regions of Tennessee. The work with dried legumes is especially interesting and valuable, as it has shown that these food products when well prepared are very thoroughly assimilated and are economical and valuable sources of nutritive material, particularly protein.

## PUBLICATIONS.

Since the nutrition investigations were first undertaken, 50 technical bulletins and 30 Farmers' Bulletins and other popular summaries have been issued. Abstracts of reports of nutrition investigations have also appeared regularly in the Experiment Station Record, and numerous popular summaries in the series of Farmers' Bulletins entitled "Experiment Station Work." The food and nutrition publications the past year have included three popular summaries and three technical bulletins, as well as an article for the annual report of this Office, and

reports of the progress of the nutrition investigations as a whole. The publications were as follows:

Studies on the Digestibility and Nutritive Value of Bread and Macaroni at the University of Minnesota, 1903-5. By Harry Snyder. (Bul. No. 156, pp. 80.)

This bulletin reports the results of digestion experiments made with different grades of flour ground under uniform conditions from the same lots of Oklahoma and Oregon wheats, digestion experiments with macaroni made from American-grown durum wheat and similar experiments with bran flour, wheat-germ flour, and durum wheat breakfast food. As in earlier digestion experiments, it was found that the standard patent flour furnished more digestible nutrients and available energy pound for pound than the coarser flours, though all were of high nutritive value.

The macaroni had practically the same digestibility as standard patent flour and the conclusion seems warranted that in nutritive value it compared favorably with such flour and with imported macaroni of a good quality.

A Digest of Japanese Investigations on the Nutrition of Man. By Kintaro Oshima. (Bul. No. 159, pp. 224.)

Investigations on the composition of food materials and the amount of food consumed by persons of different ages, occupations, and living in different circumstances are summarized, as well as results of digestion experiments, nitrogen metabolism experiments, and other special studies with the purpose of presenting a digest of Japanese food investigations, particularly those which have been published in the Japanese language, and hence available to few students outside of Japan. The place of rice in the diet, the use of bean cheese or bean curd, and other soy-bean preparations to supply the amount of nitrogenous material required, and related questions are discussed, and factors deduced for computing the fuel value of Japanese food materials.

Studies on the Influence of Cooking upon the Nutritive Value of Meats at the University of Illinois, 1903-4. By H. S. Grindley and A. D. Emmett. (Bul. No. 162, pp. 230.)

Details of 51 experiments are reported undertaken to study the nutritive value of different kinds and cuts of meats cooked in various ways. The investigations as a whole are discussed with special reference to the losses involved in cooking meats, the amount and nature of the nitrogenous constituents of raw and cooked meat, the development of flavor as related to methods of cooking, the nutritive value of broth made from meat and bones, and related topics. It is shown that methods of cooking may materially modify the appearance, texture, and flavor, and hence the palatability and table quality of meat, but on an average do not exercise any considerable effect upon its total nutritive value, meat prepared in all the common household ways being an important source of both protein and energy.

The Guinea Fowl and Its Uses as Food. By C. F. Langworthy. (Farmers' Bulletin No. 234, pp. 24.)

This bulletin gives a summary of data regarding varieties of guinea fowl, their habits and care, marketing, cooking, composition and food value of the flesh and eggs, and related questions. This class of poultry is coming to be much appreciated as a substitute for game, and market demands for it are increasing.

Cereal Breakfast Foods. By C. D. Woods and Harry Snyder. (Farmers' Bulletin No. 249, pp. 36.)

The digestibility and nutritive value of cereal breakfast foods is discussed and data based on several years' experiments at Maine and Minnesota Agricultural Experiment stations summarized. As a whole, the bulletin discusses the available information on the preparation of cereal breakfast foods, their nutritive value, methods of cooking, the relative cost of this class of food materials, and their place in the diet. A section is also devoted to cereal products used as coffee substitutes.

Preparation of Vegetables for the Table. By Miss Maria Parloa. (Farmers' Bulletin No. 256, pp. 48.)

On the basis of experiments and practical tests, Miss Parloa discusses the preparation of vegetables for the table, and summarizes information on the structure and composition of vegetables, their classification, the principles which underlie vegetable cookery, the waste involved in preparing and cooking vegetables, and similar questions. Type recipes for cooking vegetables are given.

Fruit and Its Uses as Food. By C. F. Langworthy. (Yearbook of Department of Agriculture for 1905, pp. 18.)

This article gives a brief summary of data regarding the composition of fruit, color, flavor, ripening and its effect on composition, the place of fruit in the diet, the comparative value of raw and cooked fruit, the hygiene of fruit, and related questions.

The usual summaries have been prepared for publication in the Annual Report of the Department and that of the Office of Experiment Stations, and some of the Farmers' Bulletins and other popular publications have been revised.

In addition to the above, 5 technical bulletins have been prepared and one Farmers' Bulletin has been rewritten in considerable part. These await publication.

#### RESULTS OF NUTRITION INVESTIGATIONS.

In general, it may be said that the investigations at the University of California have demonstrated the fact that raw fruits and nuts may furnish a considerable proportion of the total nutrients of the diet at a reasonable cost, that these foods are fairly well digested, and that they should be regarded as staple articles of diet rather than food accessories. Fruits and nuts are most useful as food when eaten in combination with other food materials rather than in large quantities alone, or at the end of an otherwise hearty meal.

The studies of wheat and corn products at the Maine Agricultural Experiment Station and the University of Minnesota have shown the comparatively high digestibility of corn bread of different sorts and of wheat flour prepared in a number of other forms than bread.

The continued study of cereal products offers further proof of the high nutritive value of all such food materials and the desirability of using different kinds of meal and flour for securing variety in the diet without additional cost or undue labor. As a whole, the different flours, meals, and other cereal foods found on the market are inexpensive sources of nutrients as compared with many other common food materials, and their importance in the diet can hardly be overestimated.



The experiments with meat carried on at the University of Illinois have shown that different methods of cooking have less effect upon total nutritive value and digestibility than has been commonly supposed, and that it is possible to control cooking processes so that a fairly uniform product may be obtained when similar cuts of meat are cooked by either boiling or roasting. As a whole, meats of different kinds and cuts supply nutritive material, particularly protein and fat, in forms which are very thoroughly assimilated.

The importance of the investigations on the digestibility and nutritive value of cheese carried on at Middletown, Conn., can hardly be overestimated, since the results have shown that cheese did not produce digestive disturbances, as is commonly supposed, and may be used in comparatively large quantities as an inexpensive source of protein and energy in the diet. When intelligently used, cheese should be combined with cereal foods, fruits, and similar products, and when eaten in considerable quantity should replace rather than supplement such nitrogenous foods as meat, eggs, and dried legumes.

The investigations with the respiration calorimeter have furnished new and valuable factors regarding the average amount of energy required by a man at rest and performing different kinds of work, the carbon dioxide and energy output at different times of the day, and under different conditions of rest and work, the diurnal variations in body temperature and related topics. Such factors have practical application in considering the food requirements of man and are also of great value in the teaching of physiology and the discussion of physiological problems.

In the investigations in Baltimore the fact has been clearly brought out that the food requirements of the aged are less than those of younger persons in full vigor, and a factor has been proposed for use in calculating the results of dietary studies, which expresses this relation.

#### NUTRITION INVESTIGATIONS FOR 1906-7.

During the coming fiscal year it is proposed to continue the cooperative nutrition investigations on the same general lines as heretofore. With a view to securing greater efficiency in the administrative and editorial work connected with these investigations, arrangements have been made, in accordance with the terms of the last appropriation act, for the transaction of this business at Washington, and Dr. C. F. Langworthy has been appointed chief of nutrition investigations.

At the University of California it is proposed to continue the work with fruit and nuts, paying especial attention to the digestibility of jams, jellies, preserves, nut butters, and other fruit and nut products, as compared with raw fruits, and to studies of dishes consisting in considerable part of fruits and nuts, as compared with simple mixed diets composed of similar ingredients eaten separately.

In the investigations which have so far been carried on at Middletown, Conn., on the nutritive value of cheese, the digestion experiments have been made with healthy young men. Additional experiments are contemplated with other types of subjects, as well as studies with other sorts of cheese than American Cheddar. Additional experiments are also required on the ease and rapidity of digestion of cheese and the value of different sorts of cheese as sources of energy. In these investigations the respiration calorimeter will be used. A method of

studying the rapidity of digestion of cheese has also been devised, which depends on variations in the elimination of nitrogen.

With the aid of the respiration calorimeter it is also proposed to continue the studies of the energy requirements of persons of different types and engaged in different sorts of muscular and mental work. As heretofore, experimental methods will receive attention.

As occasion offers, studies of the nutritive value of tropical food materials and food requirements of persons living in hot climates will be continued at the Hawaii Agricultural Experiment Station.

At the University of Illinois it is proposed to pay attention to the digestibility of meat and meat products, with special reference to the digestibility of meat dishes, as compared with rations composed of similar ingredients not cooked together, and to study the effects of other methods of cooking than boiling and roasting upon the nutritive value of the cooked product, the losses sustained in cooking, and similar questions. It is also proposed to reduce to pedagogical form the large amount of information which has accumulated in connection with these meat investigations, in order that teachers of home economics in the agricultural colleges and other educational institutions may have the benefit of the data in their work.

Louisiana is an important center for the rice industry of the United States, and the Louisiana Experiment Station offers exceptional facilities for studying the nutritive value of rice and rice products. It is therefore proposed to begin a series of cooperative investigations which will show how thoroughly rice is digested, the effect of different methods of cleaning, polishing, and preparing rice for the market upon its food value and the possibilities of using rice polish and other by-products as food and related questions.

At the Maine Agricultural Experiment Station digestion experiments are contemplated with water-ground corn meal prepared for the table in a variety of ways and other corn products, in order that these may be compared with ordinary corn meal as regards digestibility and the total nutritive material which they supply to the body. Special attention will also be paid to the character and amount of the metabolic products which result from the digestion of the food materials under consideration.

At the University of Minnesota it is proposed to study the ease and thoroughness of digestion of flour products other than bread by artificial digestion experiments, which it is believed are particularly well suited to the problem, and to compare the digestibility of dishes containing flour and several other ingredients with a ration of similar materials not cooked together, and to study the relation between methods of handling and preparing the dough and similar factors upon the flavor, quality, and appearance of bread produced.

Studies of the ash constituents of food will be continued at Columbia University, New York, special attention being paid to calcium and magnesium, the object of the investigations as a whole being to obtain figures which will show the amount of these constituents required per day on an average and the foods and food combinations best fitted to supply them, in the same way that the previous investigations have supplied similar data with reference to iron.

It should be remembered that up to the present time very little accurate information has been available regarding the relative value of the mineral constituents of food, the quantities of each which are

needed, and similar questions. These topics are of great importance from a dietetic standpoint, and also from the standpoint of the effect of different mineral constituents of soil and fertilizers upon various crops raised for food purposes.

In cooperation with Teachers' College of Columbia University it is proposed to continue investigations which have reference to the pedagogics of nutrition.

The plans which have been formulated also contemplate studies at the University of Tennessee, to ascertain the kinds and amounts of foods used in different institutions and by other large groups fed under a variety of conditions.

With our present resources, supplemented by the generous help of the cooperating institutions, it is possible to continue the work already under way, and as certain phases of the investigation are completed from time to time to make at least a beginning along some of the new lines. It is not possible, however, to adequately meet the demands for information (necessarily dependent upon investigation) which are made by teachers in the agricultural colleges, universities, medical colleges, and other educational institutions, and by instructors in domestic science, students, institution managers, and those interested in settlement work and other philanthropic enterprises, nor the requests made by the general public for miscellaneous information regarding nutrition and summaries of the data already accumulated.

In the United States there are 44 agricultural colleges for white students, or other similar institutions receiving Government aid, where courses in home economics are given, and 45 similar institutions for colored people. This list does not include the schools maintained in the Army and Navy for instruction in the preparation of food and similar topics. Aside from the institutions enumerated there are at least 50 schools of collegiate grade where instruction is given regarding food and nutrition and other branches of home economics, and at least 100 institutions where the course is not so advanced as that given in colleges. Statistics are not available regarding the number of medical colleges which give special courses in nutrition and dietetics, but it is safe to say that in almost every such institution some attempt is made to cover these subjects. The total number of high and grade schools where instruction is given along these lines is very large.

In view of the widespread interest in the work and the important bearing of the food problem on the development of the agricultural resources of the country, and upon the instruction at the agricultural colleges and other institutions, it seems obvious that the pedagogics of nutrition should receive attention, and it is a matter of great importance to formulate the available data in such a way that the subjects may be more satisfactorily taught than is at present the case. Such a plan necessitates closer cooperation with teachers and investigators, and it is very important that the Department, interested as it is in agricultural education, should make a closer study of the courses of instruction in home economics or domestic science, particularly the branches of this subject which pertain to agriculture, as they are taught in the agricultural colleges and other institutions throughout the country, with a view to aiding teachers in their work to a greater degree than at present.

Satisfactory text-books on food and nutrition (important branches



of home economics) are not available, and at present a large proportion of the teachers in the agricultural colleges and other schools depend on Department publications to supply their place. There is a demand for more nutrition publications, both technical and popular, like those now issued, and also for new series on somewhat different lines. For instance, simple leaflets are needed for instruction in primary grades, and charts showing in graphic form the results of nutrition investigations, as well as leaflets giving directions for preparing specimens and other illustrative material.

It is also important to gather together and place in pedagogical form the widely scattered facts relating to food values, food economy, the storage and transportation of food, the principles which underlie cookery, proper food combinations, body requirements, digestibility and hygiene of food, the possibilities of introducing new food products or demonstrating the great food value of many materials which are at present generally unappreciated, and related questions. In the teaching of agronomy, animal production, and other agricultural topics, pedagogical work undertaken under the auspices of the Department, and similar to that proposed, has resulted in the formulation of very satisfactory courses of instruction, and it seems certain that this plan would give equally good results.

While much information regarding the results of nutrition investigations has been already disseminated, there is need of a more effective system for showing the people in rural regions and towns the practical benefits to be derived from the systematic application of these results in the home. A plan has therefore been prepared for undertaking demonstration work on food subjects in a way which experience gained in other lines has shown to be satisfactory. It is proposed to send competent instructors to representative assemblies in different regions of the country to give short courses and demonstrations regarding the relative value of the different agricultural products which are used as food and in the principles of nutrition and the hygiene of living, basing their teaching on the large amount of data available as a result of the nutrition investigations. For this demonstration work it would be best, doubtless, to select localities which have manifested most interest in the problem and which may be made effective centers for the dissemination of information to large numbers of people. A preliminary study of the situation has made it evident that the demand already exists for work of this nature.

It is proposed that the Department demonstrators shall meet organizations of teachers, mothers, and home makers and bring to their attention the most important facts regarding the relative food value of different food crops and other food products; suitable food combinations; dietary standards and ways of securing a rational and well-balanced diet; economy in the purchase of food and in the use of articles of home production; sanitation and hygiene as related to the care, storage, handling, and marketing of food; the conservation of any surplus food supply; the principles which underlie cookery and something of the digestibility and utilization of food by the body, and the factors which influence the functions concerned in body nutrition. The basis of such teaching will necessarily be the Department technical and popular bulletins reporting and summarizing the results of the nutrition investigations. Series of specimens illustrating the subject

graphically could also be provided, as well as charts and photographs. In so far as possible it is proposed to work in connection with State institutions and officers, teachers' institutes, farmers' institutes, clubs for home study, and similar organizations.

The object of this work will be to aid and supplement, rather than to control, the work along these lines already being done by State and local organizations. At present the investigations made by the Department do not have their full effect, because there is no opportunity for systematic attempts to bring them to the attention of the people for whose benefit they are conducted.

Success has attended some of the demonstration work which the Department of Agriculture has undertaken in other lines, and there is every reason to believe that demonstration work in nutrition would be equally successful. The nutrition investigations as at present carried on are well organized along the lines which must be the foundation of teaching and demonstration under any circumstances, and in the future the special requirements of this educational work should be borne in mind in making plans for investigations.

Some attention has already been given to making plans for presenting the results of the nutrition investigations in the way outlined, and it is believed that by the means proposed it is possible to bring the important facts of nutrition more directly to the home makers than in any other way. A moderate outlay for work of this kind will, it is believed, make the publications of the Department on human nutrition far more effective aids toward the right use of the food supply of our people.

The proper and economical feeding of families or groups—that is, the best methods of utilizing the food products which come from farms, is a subject the importance of which can hardly be overestimated, and a knowledge of the important facts regarding the nutritive value of different foods can not fail to bring about improved standards of living on the farms and in other places, and benefit the producer, the distributor, and the consumer of food products, for their interests are mutual.

A great deal of information is already available and it is each year becoming more possible to apply to home management the same system of control of conditions which has been so successfully applied to farm management and to business enterprises.

Such nutrition work as that in which the Office of Experiment Stations is engaged is intrinsically important, is national in its scope, and is directly connected with agriculture, and especially with the work of the agricultural colleges and experiment stations. To provide for some extension of this work, particularly by increasing the studies of the relative nutritive value of such agricultural products as cereal crops, fruits, cheese and other dairy products, and meat, and the relative proportions in which such foods should be used in a well-balanced diet, and to demonstrate the ways in which the results of nutrition investigations can be practically applied in the household and utilized in courses of instruction in agricultural colleges and other educational institutions, I recommend an increase of \$5,000 in the appropriation for nutrition investigations for the fiscal year ending June 30, 1908.

## IRRIGATION AND DRAINAGE INVESTIGATIONS.

## PURPOSE AND SCOPE.

The Irrigation and Drainage Investigations of this Office continue to be under the immediate supervision of Dr. Elwood Mead, with Mr. C. G. Elliott as chief drainage expert and Mr. R. P. Teele as editorial assistant.

In my report three years ago I called attention to the need for skill and economy in the use of water in some of the older irrigated districts because of its scarcity and higher price, and stated that this Office had begun a comprehensive investigation, in cooperation with a number of States and State experiment stations, of the principles and methods which will conserve water applied to the soil, and result in an increase in the duty of water. These investigations have shown that a large part of the water, under ordinary irrigation practice, is worse than wasted, and that it is possible through better methods of distribution and more thorough tillage to irrigate much more land with the same amount of water and to benefit both soil and crops while doing this.

The practical value of these results is so obvious as not to require discussion, but they are referred to for the purpose of calling attention to the need for their wider dissemination both to benefit the individual farmer and to secure the largest results from the available water supply. The reclamation of land in the arid region is now going on more rapidly than ever before in the country's history. The Federal Government, through the Reclamation Service, is expending \$40,000,000 on canals and reservoirs to provide water for the irrigation of a large area of land now unoccupied. Private enterprise without aid or supervision, and corporations working under State supervision under the Carey Act, are expending many millions of dollars on irrigation works and making a large additional area of land susceptible of being farmed.

The important problem of the arid West is now not money but men. The need is for farmers to settle upon and improve the lands now being reclaimed. These settlers will, in most part, come from humid sections, and they will have to begin under strange surroundings the practice of a form of agriculture of which they know nothing. These settlers need to be helped at the outset by practical advice and direction, and if not so helped many of them will fail.

There is equal need for practical instruction and demonstration in the semiarid region. Settlements are being made in every part of this vast area and an agriculture distinct in its conditions from that of either the arid or humid parts of the country is being built up. In this the small but highly cultivated irrigated area, supplied with water from wells or storage, is to be a saving factor, important because of the security and comfort which it will contribute to the arid farm. Here the methods and tools for providing water and tilling the soil to conserve moisture are all important, and they should be determined by scientific investigation and brought into general use by practical illustration and demonstration.

These broad fields of western agricultural development have been the subject of much earnest study on the part of myself and my assistants in this work, in order to determine our duties and responsibilities and to



outline definitely the work coming within the scope of these investigations which will most benefit the farming interests and promote the growth and prosperity of the arid and semiarid sections. The field is so large and varied that much discrimination must be exercised in determining where work should be carried on and what this Office may or may not do.

As a result I have reached the following conclusions:

(1) That advanced investigations, to determine the principles which govern the conservation of irrigation water and the methods of irrigation and tillage which will bring the highest service from land and water, should be continued. The demand for more information in the older districts, where water is scarce and costly, has grown with each year since these investigations began, while what has been learned is being utilized to save water and increase yields on many farms which were sagebrush deserts three years ago.

(2) The encouragement and aid of beginners by practical instruction and demonstration should be greatly extended. The services of the few experts who have been employed have been so valuable that every attempt we have thus far made to withdraw one of this force from the district or State to which he was first assigned has met with protests from public officials and communities that could not be disregarded. Every one of these men has remained a fixture where he started. This, however, has prevented us from complying with requests for similar work in a number of States where the benefits would have been equally marked. Requests from State officials and Members of Congress in Wyoming, Oregon, and Idaho for work of this character now await action.

In addition to furnishing instruction and demonstration of the best methods of irrigation to settlers under Carey Act projects, it is believed that the same sort of aid should now be given to the farmers under Government reclamation works. The construction of these works has progressed rapidly and to the satisfaction of all concerned. There is now a large area of land ready for settlers, and this area will soon be increased by the completion of a number of large canals on which work is far advanced. We therefore confront, as has recently been stated by President Roosevelt, "the critical question of how best to utilize these reclaimed lands." This applies both to affording encouragement to farmers to undertake settlement and in showing them how to succeed. Without exception, the first year will be the trying year for these settlers. It is then that the largest expenditure has to be made and the plans for applying water adopted. Nothing will do so much to give these settlers confidence or contribute so much to satisfactory results as expert practical advice and direction about the plan of irrigation to be adopted, the irrigation tools to be bought, and the methods to be followed in spreading water over their fields.

(3) The settlement of the semiarid region now going on has given great importance to the utilization of small or intermittent water supplies for the irrigation of from 1 to 10 acres on each farm in this region. The security and comfort of these homes will be more certainly promoted in this way than in any other.

As yet this kind of irrigation is an experiment with great possibilities but many unsolved questions. Many farmers would avail themselves of its benefit if they knew what it would cost and the methods

they should follow. The immense volume of storm and flood waters which now run to waste can, it is believed, be utilized and add greatly to the population and productive capacity of the Great Plains region. This Office has undertaken to gather and systematize the information needed, and has designated this feature of its work "irrigation extension."

At the outset of this investigation printed reports and bulletins were relied upon almost entirely in making results available for farmers. While these are valuable, they are not enough. For the purposes of advanced research and practical illustration, publications must be supplemented by field stations or demonstration farms, where methods, tools, and results can all be seen and studied. This conclusion is based on the results of the demonstration farms which are now being conducted by this Office in California, Nebraska, and Wyoming. The station near Cheyenne, Wyo., was visited the present season by more than 5,000 farmers, and to each of these visitors the impressions and lessons were made vivid and the instruction was provided at less cost in this way than it could have been in any other. The equipment and carrying on of demonstration farms has therefore become an essential feature of the educational work in irrigation done by this Office. Such farms are now being equipped in cooperation with the State experiment stations in Colorado, Idaho, and Wyoming.

It is believed that in addition to this such a farm should be established on each important Government reclamation project, where the preparation of land for irrigation and the methods and times of applying water should be under the direction of an irrigation expert from this Office. This farm would illustrate to beginners and intending settlers how they should go to work. In addition, it should be a part of the duty of this expert to give practical directions and advice to the farmers in carrying out this work on their own lands. He should also conduct original experiments and investigations to determine the improvements and modifications of good practice which would be best adapted to the peculiarities of their soil and climate. The establishment of these farms and the giving of this practical advice will be of individual service both in getting the right kind of settlers on the various projects and in giving them a good start on the road to success. Once started, there is no doubt that these settlers will succeed and be enabled to establish homes, pay the cost of their water right, demonstrate the wisdom of the irrigation law, and insure that the reclamation fund will be prompt in starting to revolve.

(4) Even in the humid sections of the country irrigation is essential for certain crops, such as rice, and is an effective insurance against drought which, even when of short duration, is disastrous to such crops as vegetables and fruits. The irrigation of rice along the Gulf coast is of recent development, and there is need of information as to the best practice in rice culture as regards both irrigation and drainage. Such investigation has been carried on by this Office in Louisiana and Texas since 1901 and should be continued.

Investigations already made as to the irrigation of market gardens in the East show that, notwithstanding the fact that water is much more plentiful than in the West, its cost to farmers is much greater, owing to the lack of information as to the cheapest and best methods of securing it. The work already done in collecting information as to what

has been done and the methods in use should be supplemented by a study of the improvements which can be made looking to the cheapening of water supplies and better methods of application.

(5) In the United States about 600,000 acres are irrigated with pumped water, and there are immense additional areas which can be supplied with water in no other way. It is of great importance that those who are to reclaim this land be supplied with information as to the cost of machinery, cost of operation, and the efficiency of machinery. A large amount of information regarding plants now in use has been collected and published, and tests to determine the relative cost and efficiency of different types of pumps and engines and of different kinds of fuel were carried on in 1904, 1905, and 1906, and should be continued.

(6) There are certain broad questions of public policy which affect both public and private enterprise which this Department has been called upon to investigate. Among these is the relation of the State and Federal governments to the control of water supplies, and the working out of business agreements for the supplying of water to farms which will be fair to all parties and promote economy in the use of water.

In the past this Office has made studies as to the effects of laws now in force in some States and of the lack of laws in other States. Since the beginning of this work there has been a large amount of legislation on this subject and our published reports have done much to direct this into the best channels. This work is being supplemented by studies of the existing forms of organization and business arrangements to determine what forms afford the best security for the capital invested and give the best assurance that the water will be distributed equitably among farmers.

(7) When drainage became a part of the work assigned to the Office of Experiment Stations the most urgent demand for it came from the irrigated lands of the far West. When water was first applied to these lands the dryness of the soil appeared to be the only barrier to its productiveness. Abundant supply and free use of water produced highly gratifying results, but copious irrigation and natural waste from canals soon developed swamps and alkali areas in the lower levels and greatly curtailed the area of land which formerly had been productive. Lands for which valuable water rights had been obtained and upon which great expense and care had been lavished had become partially or wholly unproductive before the cause of the injury was suspected or the seriousness of the situation appreciated. At the beginning of our investigations it was not uncommon to find 10 per cent or more of the acreage of some farms seriously injured from a new and hitherto unsuspected source. When it became apparent that the cause of this was the rise of ground water and consequent oversaturation of the subsoil, a condition difficult for irrigators to appreciate, demands were at once made upon this Office for information upon land drainage and for assistance in devising practical methods for restoring fields to their former productiveness. The importance and, in a measure at least, the extent of the field were soon seen, but it was not then easy to outline clearly the character and scope of the investigations that should be undertaken. An examination of the various fields brought out the fact that the evil was more widespread than at first represented, and was spreading rapidly in the older



irrigated sections; and further, that certain peculiarities in the source and movement of the ground water required some modifications of the well-established drainage practice in humid sections if it were to be successfully applied to irrigated lands.

The water which produces a permanently saturated condition of the soil in some cases has its origin at a considerable distance from the land affected, percolating through the subsoil before it appears at the surface; in others it arises from leakage of canals and from waste from irrigated fields near at hand, but in all cases saturation moves upward from some impervious formation, at last appearing near the surface.

Previous to the appearance of water near the surface alkali not infrequently accumulates and injures crops. Hardpan, a stony stratum usually found in arid soils, deflects the course of soil water, in many instances causing patches of saturated soil accompanied by alkali. The subsoil is often so completely saturated to a depth of 5 to 7 feet that drainage ditches can be excavated and maintained only with great difficulty, especially where they are required to be deep in order to intercept the water currents having their sources at higher levels.

The drainage work of this Office includes the engineering, agricultural, legal, and business problems involved in the reclamation of overwatered lands. The work thus far done has been confined to important projects where there is need of State or community action in order to establish sufficient drainage systems. In some sections, where farmers do not appreciate the value of drainage or have doubts as to its feasibility, demonstrations on a small scale have been made. In others, where the isolated attempts of individuals to drain their own farms are inadequate, definite plans and estimates for more comprehensive projects have been prepared as an encouragement to self-help and to insure proper results when the work is done.

Such a variety of conditions are encountered that special examinations, and in some instances experiments, are required prior to the adoption of any plan of improvement. It is now well understood by irrigators that adequate drainage is the first and most important step to be taken in the reclamation of water-logged land and also in the removal of alkali resulting from oversaturation. The results obtained from drainage systems, installed in accordance with plans made under the supervision of our drainage engineers, though not unaccompanied with difficulties, have been successful and the cost of such work has been kept within profitable limits. As the results have become known the work has been enlarged and extended by farmers at their own expense, thus indorsing in a most practical way the methods that have been suggested and recommended for the prevention of the evil and the restoration of the injured lands.

Work in the State of Utah may be referred to as one example. In 1904 two farmers at Hyde Park, Cache County, with the assistance and under the direction of this Office, laid tile drains to reclaim wet meadow land for the growing of the more profitable crops of grain and sugar beets, and to prevent the ruin of adjoining beet fields upon which ground water was encroaching to an injurious extent. But few drains were used, but they were of ample size and placed 4 feet deep. The cost of the drainage was approximately \$11 an acre. The wet meadow was broken and planted to wheat, which yielded 50 bushels per acre. The sugar beets which followed the wheat promise a yield of 20 tons per acre and a gross return of \$90 per acre. The field when in grass

did not give a return to exceed \$20 an acre and the land was yearly becoming more swampy. Owners of similar land in that locality are now extending the work with great confidence in the results. It is observed that drains were laid in a field in the fall of 1905 where wheat was destroyed by seep water and surface alkali. The crop of 1906 was excellent, both water and alkali having disappeared as a result of the drainage provided the fall previous.

The Utah legislature of 1904-5 made a liberal appropriation for irrigation and drainage investigations, \$4,000 of which was set aside for drainage, together with a like amount appropriated from this Office, which constitutes a fund for cooperative experiments in the State. These have been established in four different counties. Those installed in 1905 in Emery and Washington counties were attended with unusual difficulties in construction, arising from the structure and saturated condition of the soil. The outlook for their success, however, is so favorable that other work has been started, without assistance from the cooperative fund, where drainage was formerly pronounced impossible and visionary. Drains in these several localities are regarded as experimental. Observations of the fluctuations of the ground water are recorded weekly to determine the manner in which the drains affect the water table, and such modifications are made in the drains as minute observations show are necessary in order that the best method of reclaiming the land may be developed.

The experimental drainage work in the Yakima Valley, Washington, is of older standing and has established the practicability of draining the lands which are injured by waste surface and underground waters which flow from the higher irrigated lands. As a result of the execution of a single project laid out by this Office (described in Report of Drainage Investigations for 1903), there have been 3 miles of drains of the covered type constructed on lands contiguous, 5 drainage districts have been organized in the county under the State law, and not less than 35 miles of open and covered drains constructed. The lands covered by district organizations are injured more or less by alkali, and farmers are already taking measures to restore such fields or parts of them as have been injured. It should not be assumed that the drainage and restoration of these lands is an easy task. In many respects the undertaking is beset with more perplexities and difficulties than usually attend the bringing of water to the land in its original arid state.

The practicability of underdraining the stiff black clay soils occurring in the humid belts has been questioned by some and denied by others. Experimental drains were planned and executed under the supervision of this Office at the expense of a landowner during the fall of 1905 to test the efficiency of such drains in the heavy soils of the valley lands of the Neosho River, Kansas. Reports from the field sustain the prediction that the yield of corn from this tile-drained land will be four times as great as upon the field adjoining it, which is not drained. As a result of this all doubt upon that point is removed and the underdrainage of other similar land in that vicinity is being prosecuted with diligence.

In the humid States drainage promises to do as much for agriculture as irrigation will do in the arid ones. The area of land needing drainage is about equal to the area which can be irrigated and much of it has equal productive capacity. This land at present has little

or no value for agricultural purposes, is a menace to the health of the surrounding country, and a serious obstacle to the development of manufactures and commerce. During the past few years there has been a marked awakening to the latent possibilities of the lands requiring drainage and general movement for the reclamation of these lands is now going on. This has led to a constantly increasing number of requests for advice and investigations by this Office.

Drainage, like irrigation, is a matter requiring organization and a considerable measure of public supervision. The first step in the reclamation of land by drainage is the enactment of proper laws for the organization of drainage districts, and to fix the legal and business arrangements under which money for the work is to be raised and the benefits determined. The experts of this Office have been frequently called upon by State officials, legislators, and the managers of district enterprises for advice and suggestions as to both laws and policies. In those sections where drainage will be of the most benefit the obstacles to be overcome are so great that the work will not be undertaken until there is better understanding of the subject and a general agreement as to policies that should be followed.

This need for definite information as a basis for future action was shown by a number of bills and resolutions introduced at the last session of Congress, similar to H. R. 20022, which required the Secretary of Agriculture to prepare and submit a report to Congress, giving the following information:

First. The location and area of lands in the United States that are swamp and overflowed and susceptible of being drained and made fit for agriculture.

Second. The value and effect of drainage on such land and on the public health and upon agriculture.

Third. Existing legislation of the different States and localities on the subject of drainage and operations thereunder.

Fourth. Foreign drainage policies and their result, and the relation of the Federal Government to local authorities and legislation on said subject.

While the pressure for information and advice with respect to the drainage of particular areas has delayed the beginning of a study of the broader phases of the subject outlined in the above inquiries, this work has now been taken up and data regarding the lands needing drainage and the laws and policies governing drainage in the several States is being collected and compiled.

The demand for the extension of the work of this Office in irrigation and drainage has been so widespread and urgent during the past year that Congress at its last session made appropriations for these branches of our service materially in excess of the estimates submitted. In spite of this increase of our funds the pressure for this work is so great that it will not be possible for us to satisfy all reasonable demands the present year. I therefore recommend that the appropriation for the irrigation and drainage investigations for the fiscal year 1908 be not less than \$150,000.

#### IRRIGATION AND DRAINAGE WORK IN THE SEVERAL STATES.

The following statements show the character of the work done in 1905 and 1906 in the several States:

##### IRRIGATION.

CALIFORNIA.—The work in California is under the direction of Prof. S. Fortier, whose headquarters are at Berkeley, at the State experi-



ment station, which furnishes office room free of charge. The State of California also contributed \$7,500 toward the expenses during the past fiscal year.

During the seasons of 1904 and 1905 tests of pumps in use were made by Professor Le Conte, of the State University, and Mr. Tait, of this Office. Results of the work in 1904 were published last year (O. E. S. Bul. 158), and during the winter of 1906 a report of the tests made in 1905 was prepared.

The experiments begun in 1904 by Professor Fortier to determine quantities of water consumed by plants in the processes of growth, and the amounts of water lost by evaporation under different methods of cultivation, were continued during the season of 1905 and supplemented by studies of the percolation of water in surface irrigation to determine what proportion of it passed beyond the reach of plant roots in different soils and under various methods of application. The latter work was done by Prof. R. H. Loughridge, of the University of California. The reports of this work are now being prepared for publication.

In 1906 a study of how to prevent seepage in ditches and canals was begun in cooperation with the State experiment station of California by Prof. B. A. Etchevery, of the University of California. It has included an examination of canal linings already in use throughout southern California and experiments at Modesto to determine the efficiency of crude oil, asphalt, cement, and clay for lining and puddling canals.

In the Imperial Valley, in southern California, measurements of the quantities of water used on new lands are being made and methods of canal management are being studied by C. E. Tait, of this Office.

In the valley of Cache Creek, in Yolo County, the quantity of water diverted by a number of ditches is being measured to determine the gross duty of water, and under these ditches measurements are being made to determine the duty on individual fields and of seepage and evaporation losses. The work in this section includes also studies of soil moisture, evaporation from soils and water surfaces, water absorption, root development in characteristic soils, and the relation of air temperature to soil and water temperature.

At Orland, in Glenn County, the use of water under the Stoney Creek Canal is being studied.

In the Modesto and Turlock irrigation districts, in Stanislaus County, the irrigation of general farm crops has not been widely practiced, and experiments are being made to demonstrate the advantages to be derived from the irrigation of grain and to determine the best methods of applying water.

COLORADO.—Experiments in applying water to sugar beets by different methods and using different quantities of water were begun in 1905 and are being continued in 1906. This work is being carried on at Loveland, in Larimer County, and Rockyford, in Otero County. The work at Loveland is being done in cooperation with the Great Western Sugar Company and that at Rockyford in cooperation with the American Beet Sugar Company.

At Canyon City experiments looking to improvement in the irrigation and tillage of orchards are being made. The water used in common practice on measured areas of orchard is being measured, and similar tracts are being supplied with different quantities of water and

receive more thorough cultivation. Records of the yields from the areas receiving different treatments will be kept. Mr. F. W. Roeding is directing all work in Colorado.

**IDAHO.**—Very large areas are being brought under ditch in the Snake River Valley, in southern Idaho, where some of the largest canals in the United States are being built. Measurements of the duty of water under a new canal are being made at Twin Falls, in Cassia County, and similar measurements are being made under canals which have been in operation for longer periods at Idaho Falls, Bing-ham County. The losses by seepage from the new ditches are also being measured and methods of prevention studied. Information is being collected as to methods and cost of preparing land for irrigation, value and extent of irrigation, and methods of canal management. This work is being done in cooperation with the Idaho Experiment Station, which contributes \$600 for the work of 1906, and is in charge of Mr. Elias Nelson.

**NEBRASKA.**—The irrigation and drainage work in Nebraska is carried on under a cooperative agreement with the State board of irrigation, the State having made an appropriation for the work. Prof. O. V. P. Stout, of the State University, is in charge. In the arid section of the State water used under typical canals in the North Platte Valley is being measured.

**NEVADA.**—The work in Nevada is done under a cooperative agreement with the State, the State appropriation being \$1,000 a year. The work is under the direction of Prof. Gordon H. True, of the State University, who is assisted by Mr. G. F. West. The water used under canals in Carson, Clover, Lovelocks, Madison, and Paradise valleys is being measured, and information is being collected as to methods and cost of irrigation. The water used on individual farms in these valleys is also being measured.

**OREGON.**—In Oregon A. P. Stover, assisted by A. E. Wright, is determining the duty of water in the Walla Walla Valley as a preliminary step to the adjudication of rights to water from the Walla Walla River. Similar measurements are being made to determine the duty of water in Umatilla Valley, where experiments on canal linings to prevent seepage are also being made. Many Oregon streams which have plenty of water in winter and spring are dry in summer, and farmers living along these streams saturate the subsoil during the flood-water season and grow good crops with the moisture thus stored. The methods and results of this form of irrigation are being studied with a view to their introduction in other sections where similar conditions exist.

**UTAH.**—The work in Utah is done under cooperative agreement with the State, which appropriated \$10,000 for irrigation and drainage investigations in 1905-6. During 1905 the irrigation work was carried on by E. R. Morgan and C. F. Brown. In 1906 the work is under the direction of Prof. W. W. McLaughlin, of the Utah Experiment Station, assisted by S. M. Kershaw.

At the Utah Experiment Station at Logan plat experiments are being made to determine the effects of applying different quantities of water, of applying it by different methods, and of applying it at different stages in the crop's growth. These experiments have been

extended through a number of years. Records are also being kept of the flow of water in the principal canals from Logan River. Weirs have been placed in these canals and continuous records of the flow will be kept during 1906.

At Morgan, Ogden, Logan, Spanish Fork, Salina, and Garland experiments are being carried on in cooperation with farmers to test the results of the application of different quantities of water and different methods of applying the water, and of cultivation.

WASHINGTON.—The irrigation work in Washington consists chiefly in the measurement of the duty of water and losses by seepage. This work in 1906 is being done by S. O. Jayne, of this Office. Records of both duty and seepage losses are being kept under the Kennewick Canal in Yakima County, in Natchez River Valley, and in the Moxee Valley.

SEMIARID REGION.—There is a large area in the arid and semiarid portions of the United States where irrigation from surface streams or large reservoirs is out of the question, but where it is possible to irrigate many small areas of land through pumping, impounding storm or flood waters, or by filling the soil and subsoil with water by copious irrigations in the winter or spring. Many farmers would undertake such irrigation if they knew what it would cost and the methods they should follow. This Office has undertaken to gather and systematize the information needed. In 1905 a demonstration farm was established near Cheyenne, Wyo., where provision has been made for testing windmills as a means of pumping water for irrigation and also for determining what can be done by irrigating with storm and flood waters outside the growing season. Similar stations have been established in Texas and Colorado, both for the purpose of making them educational centers and to test pumping machinery and different methods and implements connected with irrigation and soil tillage. A supplemental feature of the irrigation extension work was a study of small reservoirs for the storage of storm water, made by F. C. Herrmann. A report giving the results of his examination of both the construction and operation of a large number of such reservoirs has been prepared and is now ready for publication.

HUMID SECTIONS.—During the latter part of the season of 1905 Aug. J. Bowie, of this Office, made a study of the irrigation of meadows and truck gardens in the North Atlantic States, a report of which has been published as a bulletin of this Office.

RICE IRRIGATION.—Beginning with the season of 1901 this Office has carried on investigations in the rice-growing sections of Louisiana and Texas, making measurements of the quantities of water received by the rice fields from both irrigation and rainfall, and measuring the losses from the rice fields by evaporation. This work is being continued during 1906 under the direction of Prof. W. B. Gregory, of Tulane University, New Orleans, La. In connection with these experiments tests of a large number of pumps in raising water for rice irrigation were made in 1905, a report of which has been prepared for publication. Studies of the organization of the industry and of general agricultural practice in rice growing have also been made. The work of 1906 consists of studies of the duty of water and the factors which influence it, on fields at Abbeville, Crowley, Estherwood, Gueydan, and Jennings, La.



**PUMPING.**—During 1904 and 1905 a large amount of information regarding pumping plants in use for irrigation was collected, and in California and Louisiana a large number of mechanical tests were made to determine the efficiency of different types of engines and pumps, and to measure the fuel consumption in raising water for irrigation. The most striking facts brought out by the investigations were the great increase in cost per unit of output of operating small plants over that of operating larger plants, and the great variation in the cost of operating similar plants. The tests made in 1905 brought out, in an even more striking manner, the same facts. In a series of tests made in California, the gasoline consumed per horsepower hour output, by the smallest plants tested, was 0.5 gallon, while with the larger plants it was 0.2 gallon; the fuel consumption in the smaller plants being  $2\frac{1}{2}$  times as great as that in the larger plants.

A comparison of the results obtained with centrifugal pumps using gasoline, electricity, and steam as motive powers shows that at the prevailing prices the cost of raising 1 acre-foot of water 1 foot was, with gasoline,  $1\frac{1}{2}$  to 5 cents; with electricity,  $4\frac{1}{2}$  to 10 cents; and with crude oil,  $1\frac{1}{2}$  cents up. Computing the fixed charges at 20 per cent of the cost of the plant, the total costs of raising 1 acre-foot of water 1 foot with the different fuels, are: Gasoline, 4 cents up; electricity, 7 to 16 cents; steam, 4 cents up.

The tests above referred to were made on pumping plants in the vicinity of Pomona, Cal., and show that the actual gasoline consumption of these plants is nearly 50 per cent above what it would have been had they all been operated as economically as the best plants, showing a great opportunity for saving in fuel cost of pumping water.

**IRRIGATION INSTITUTIONS.**—As a part of the studies of irrigation institutions a report on The State Engineer and His Relation to Irrigation, by R. P. Teele, was published during the year. It is planned to supplement this by a study of the regulations of canal companies, thus making a complete discussion of the laws and customs which govern the actions of farmers in securing and using water. For this latter report a large amount of information has been collected.

In addition to the foregoing all the field men connected with the work of this Office have been instructed to collect information as to canal management, the cost of water to farmers, regulations governing the distribution of water, etc.

**GENERAL STUDIES IN IRRIGATION.**—There is at present a very rapid settlement of the irrigated lands in the West, settlers coming very largely from sections where irrigation is not practiced. This makes a large demand for manuals giving practical directions for preparing land for irrigation and applying water. A former bulletin along this line, published by this Office, is being revised to make it more complete, and there is now in preparation a farmers' bulletin on the same subject which is not so complete but gives the more general directions which settlers need.

#### DRAINAGE.

**ARKANSAS.**—Work in Arkansas, to be begun in 1906, will include a preliminary examination of the St. Francis River to estimate the value of the bottom lands and to outline a general plan for its drainage, to be done in cooperation with the St. Francis River and Improvement

Association; and an examination of the Grand Prairie in Lonoke and Arkansas counties to outline methods for the main drainage of these level prairie lands.

CALIFORNIA.—Preliminary plans for the drainage of the Fresno district, where the ground water has risen so near the surface as to injure large areas of vineyards, were made some years ago, but the works have not been built, owing to the impossibility of securing cooperation of the landowners. During the present year experiments to determine the feasibility of draining smaller areas by pumping the water from sumps have been begun. This work will include also the pumping of soil water from greater depths for use during the season when river water is not available. Somewhat similar work is being done in the Turlock district, where the ground water is already coming dangerously near to the surface, although irrigation has been practiced but a few years.

INDIANA AND ILLINOIS.—A study of the drainage problems of the Kankakee marshes begun in 1904 was continued during 1905. The work for these two years consisted in an examination of the marshes and a collection of information as to what had already been done toward their drainage and the productivity of the drained lands. Most of the work which has already been done is in the upper end of the valley. The work being done in 1906 is the making of surveys to locate and recommend the size of a new channel for the river in order that it may carry off the water from the upper part of the valley, and the location of branch lines which will relieve the lands in the lower part of the valley.

KANSAS.—During the season of 1906 a survey is being made in the valley of the Neosho River, extending from Emporia to the south line of the State, to determine the kind and cost of improvements necessary for the control of the stream and the protection of the bottom lands. Lawrence Brett is in charge of the party which is making these surveys.

MINNESOTA.—In the valley of the Red River of the North there are very large areas of farm lands which need drainage, and so far tile drains have not been used because of the fear that the freezing to depths of about 6 feet each winter will destroy the usefulness of these drains. Experiments to determine whether this is true have been planned, and will be carried out at the Northwest experiment farm of the State of Minnesota at Crookston. The plans for this work have been prepared by this Office, and the drains are to be laid by the station under the supervision of this Office. Arrangements have been made for observing the effects of these drains through a number of years.

MISSISSIPPI.—Two experiments are being made in Mississippi to determine the efficiency of tile drains in the black delta clays of that region. One of these is at the Marcella plantation and the other at Clover Hill farm near Clarksville. In both cases the plans were made by this Office and the work is to be carried out by the landowners. The landowners will also report to this Office the effects of these drains for some years.

Preliminary surveys for the drainage of the Black Bayou, in Washington County, are also being made at the request of the landowners. The proposed drainage will affect about 200,000 acres, and if these

surveys show that the work is feasible it will be carried out by the landowners.

NEBRASKA.—In 1905 plans were made for the drainage of a tract of land at Lexington, Nebr., which had been injured by seepage water and the accumulation of alkali. Drains have been put in according to these plans, and during 1906 records of the depths of ground water are being kept to determine the effectiveness of the drains. This work is being done in cooperation with the State of Nebraska.

NEW YORK.—Preliminary surveys for the drains of the Oak Orchard Swamp, in Genesee and Orleans counties, N. Y., comprising approximately 12,000 acres, were made in the spring of 1906. These plans were made by this Office and are to be carried out by the landowners, who will report to this Office the effect of the drains.

Plans have also been made for the protection and drainage of about 200 acres of tidal lands on Long Island, the tract being representative of very large areas of such lands in New York and New Jersey. The work done by this Office included plans for embankments and automatic sluice gates which would shut out the salt water and at the same time allow the escape of the drainage water from the marsh at low tide. These plans were prepared by J. O. Wright.

NORTH DAKOTA.—During the year 1905 surveys were made for the drainage of 2,500 square miles of land in the valley of the Red River of the North. The expense of this work was shared between this Office, the State engineer of North Dakota, and the counties in which the work was done. During 1905 these surveys extended through Cass, Traill, Grand Forks, and Walsh counties. In 1906 the surveys are being continued through Pembina County. John T. Stewart of this Office is in charge of the surveys.

Experiments in the use of tile drains similar to those made at Crookston, Minn., are being made on the State experiment farm at Fargo, this Office preparing the plans and the station carrying out the work and reporting as to the effects.

SOUTH CAROLINA.—Surveys and examinations were made during 1905 to determine the conditions of tidal river lands, especially those bordering Cooper River, the object being to protect these lands from the inflow of salt water and restore them to productiveness, and to determine whether more complete drainage will not fit them for the production of dry-land crops. During 1906 surveys of increased areas are being made in Charleston County. J. O. Wright is in charge of this work, which is being done in cooperation with the Charleston County sanitary district.

TENNESSEE.—The South Fork of Deer Creek and the lands adjoining it in Madison County will be surveyed in 1906 to determine what improvements are necessary to protect the land from overflow, and the probable benefits from the carrying out of these improvements.

TEXAS.—In the winter of 1906 investigations were begun in the vicinity of Brownsville, Tex., to determine means of relieving lands which have been irrigated of the salt which has accumulated near the surface. These lands were very productive during the first years of irrigation, but the accumulation of salt has rendered them unproductive. The work includes the making of ditches of different depths



and located at different distances for the purpose of determining what methods will produce the best results. This work is being done by Omer Fairley.

UTAH.—Investigations and experiments in the drainage of over-irrigated lands in different parts of the State were begun in 1905. This work is done in cooperation with the State of Utah, which has made appropriations for this purpose. Experimental drains were made at Huntington in Emery County, at St. George in Washington County, and at Garland in Boxelder County. All of this work is done in cooperation with the landowners, the office furnishing the services of an engineer, who makes the plans and superintends the construction. The landowners furnish the work and have agreed to make observations as to the effect of the drains. C. F. Brown is carrying on this work.

WASHINGTON.—Irrigation in the Yakima River Valley in Washington has raised the ground water to such an extent that considerable areas which were once productive have been injured by water and alkali. Plans for the drainage of a number of tracts in this valley have been made in past years, the carrying out of which has resulted in the extension of the work to several points in the valley. Plans have been made for the drainage of the irrigated land in the Moxee Valley, and surveys are completed for the drainage and protection from overflow of 25,000 acres of fertile land in the valley of the Colville River, Washington.

#### PUBLICATIONS ON IRRIGATION AND DRAINAGE.

During the year ended June 30, 1906, the following publications relating to irrigation and drainage have been issued:

Bulletin No. 157.—Water Rights on Interstate Streams: The Platte River and Tributaries. By R. P. Teele and Elwood Mead. Pp. 118, pls. 4, figs. 3.

The Platte River and its tributaries lie within three States—Colorado, Wyoming, and Nebraska. The one source of supply is therefore subject to the laws of three States. This report is a discussion of the rights to water from this source of supply as they have arisen under the laws and physical conditions in the three States. Mr. Teele gives the results of the field work and Doctor Mead a general discussion of water laws. These have been printed as separates, which are available for distribution.

Bulletin No. 158.—Annual Report of Irrigation and Drainage Investigations, under the direction of Elwood Mead, Chief of Irrigation and Drainage Investigations, Office of Experiment Stations. Pp. 755, pls. 12, figs. 129.

This is the general report of Irrigation and Drainage Investigations in 1904. It contains the following reports: Review of the Irrigation Work of the Year 1904, by R. P. Teele; Irrigation in Santa Clara Valley, California, by S. Fortier; Mechanical Tests of Pumping Plants Used for Irrigation, by J. N. Le Conte; The Distribution and Use of Water in Modesto and Turlock Irrigation Districts, California, by Frank Adams; Relation of Irrigation to Yield, Size, Quality, and Commercial Suitability of Fruits, by E. J. Wickson; Irrigation Conditions in Imperial Valley, California, by J. E. Roadhouse; Irrigation in Klamath County, Oreg., by F. L. Kent; Irrigation Investigations in the Yakima Valley, Washington, by O. L. Waller; Irrigation Condi-

tions in Raft River Water District, Idaho, 1904, by W. F. Bartlett; Irrigation Investigations at New Mexico Experiment Station, Mesilla Park, 1904, by J. J. Vernon; Irrigation Investigations in Western Texas, by Harvey Culbertson; Pumping Plants in Texas, by C. E. Tait; Irrigation in Southern Texas, by Aug. J. Bowie, jr.; Rice Irrigation in Louisiana and Texas in 1903 and 1904, by W. B. Gregory; Rice Irrigation on the Prairie Land of Arkansas, by C. E. Tait; Irrigation Experiments at Fort Hays, Kans., 1903 and 1904, by J. G. Haney; Irrigation near Garden City, Kans., 1904, by A. B. Collins and A. E. Wright; Pumping Plants in Colorado, Nebraska, and Kansas, by O. V. P. Stout; Irrigation near Rockyford, Colo., 1904, by A. E. Wright; The Irrigation and Drainage of Cranberry Marshes in Wisconsin, by A. R. Whitson; Report of Drainage Investigations, 1904, by C. G. Elliott.

Bulletin No. 167.—Irrigation in the North Atlantic States. By Aug. J. Bowie, jr. Pp. 50, figs. 7.

This report contains descriptions of a large number of small irrigation plants in Maryland, Pennsylvania, New Jersey, New York, Rhode Island, and Massachusetts.

Circular No. 65.—Irrigation from the Upper Snake River, Idaho. By H. G. Raschbacher. Pp. 16, fig. 1.

This gives a general description of the irrigation works along the Snake River from St. Anthony to the mouth of the Salmon River.

In addition to the above the following reports were submitted for publication, but were not actually printed during the year:

The State Engineer and His Relation to Irrigation. By R. P. Teele. (O. E. S. Bul. 168, pp. 99, fig. 1.)

This covers the work of the State engineer in the arid States having such officials and the general subject of public control of the use of water for irrigation.

Irrigation in Montana. By Samuel Fortier. (O. E. S. Bul. 172.)

This is a study of typical sections in Montana, presenting a view of the status of irrigation practice and institutions.

Irrigation in Oregon in 1905. By A. P. Stover. (O. E. S. Circ. No. 67.)

This report is made up largely of discussions of irrigation practise, seepage losses and their prevention, and winter irrigation.

Corn-Harvesting Machinery. By C. J. Zintheo.

This describes machines used in harvesting corn and gives data as to value of corn fodder and the cost of securing it.

Practical Suggestions for Beginners in Irrigation. By Samuel Fortier.

This gives the information most needed by those beginning farming where irrigation is necessary. It is to be published as a Farmers' Bulletin.

Mechanical Tests of Pumping Plants. By J. N. Le Conte and C. E. Tait.

This contains the results of a large number of field and laboratory tests of pumping plants in California.

Mechanical Tests of Pumping Plants. By W. B. Gregory.

This gives the results of tests of pumps used in rice irrigation in Louisiana and Texas.





## REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROADS.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF PUBLIC ROADS,  
*Washington, D. C., September 27, 1906.*

SIR: I have the honor to submit herewith the report of the Office of Public Roads for the fiscal year ended June 30, 1906, together with an outline of the work planned for the current and ensuing years.

Respectfully,

LOGAN WALLER PAGE,  
*Director.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

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### WORK OF THE YEAR.

Under the plan of reorganization adopted just prior to the close of the fiscal year 1905 the work of the Office was classified in three general divisions, as follows: Highways; Laboratory Tests and Investigations; Information.

Under Highways are included object-lesson roads, lectures, addresses and papers, special advice and inspection, student instruction, and experimental field work.

Laboratory Tests and Investigations comprise physical tests, routine analyses, experimental work, special investigations, student instruction, and the machine shop.

Information comprises the collection and compilation of information upon questions of road construction and management and its dissemination.

In the executive and administrative work of the Office definite progress was made toward improvement in office methods and in facilities for carrying on the work, such as better quarters, equipment, records, and library.

The following is a brief summary of the work accomplished by the Office during the past year:

#### HIGHWAYS.

This division includes all of the road construction and experimental field work, and is under the immediate direction of a chief engineer. There were, at the close of the fiscal year, in addition to the chief engineer, three assistant engineers, one consulting engineer, six engineer students, six road experts, and five expert roller operators engaged in this work. The former chief engineer of the Office was appointed State highway engineer of Illinois in January, 1906. A careful system of reports and records has been established and the work subdivided in the following manner:

## OBJECT-LESSON ROADS.

Object-lesson roads are constructed for the purpose of illustrating proper methods of road building. The local authorities furnish all material, common labor, teams, and fuel, this Office undertaking to supply supervising engineers, and in most cases the necessary machinery. In addition to this, tests are made in the laboratory to determine the best material available for the road.

Many difficulties were encountered in carrying on this work, among which may be mentioned adverse weather conditions, scarcity of labor, and delays in supplying material. The results have almost uniformly been gratifying. In many cases short sections of these object-lesson roads have subsequently led to the construction of fine systems of hard roads in the localities where they were built.

Seventeen roads were built in eleven States, representing a wide diversity in character of construction and kinds of material used. The following detailed reports show that limestone, granite, schist, chert, slag, clam shells and oyster shells, gravel, and sand-clay were used in the construction of these roads.

At most of the places where work was carried on a complete outfit of machinery, consisting of steam roller, crushing plant, road grader, sprinkler, dump wagons, plows, etc., was used. At places where sand-clay, gravel, shell, and chert were used only rollers, road graders, wagons, and scrapers were necessary. The reports show that the maximum cost of the macadam roads constructed was \$1.42 per square yard, the average 63 cents, and the minimum 24 cents. The clam and oyster shell road cost 38 cents per square yard, the gravel and chert road cost 10 cents, and the average cost of the sand-clay roads was  $4\frac{1}{2}$  cents per square yard.

The wide variation in the cost of the macadam roads is due to the difference in the cost of labor, teams, depth of material, kind of material used, amount of grading, cost of drainage and protection from floods, culverts built, length of haul of materials, and the general efficiency or inefficiency of the labor employed.

COSHOCOTON, OHIO.—Work was begun on this road in November, 1904, and continued until the early part of December, when operations were suspended on account of bad weather. Work was resumed about May 9, 1905, and the road was completed August 7, 1905. There were serious interruptions from time to time on account of strikes and other labor troubles. The road was constructed of limestone, sandstone, crushed gravel, and clay gravel. The total length of road surfaced was 4,335 feet. One section 9 feet wide and 1,600 feet long was built of crushed gravel; another section 9 feet wide and 400 feet long was built of limestone on a sandstone foundation; while still another section 15 feet wide and 2,335 feet long was built of clay gravel. The total depth of material used in each section was 10 inches rolled. No record was kept of the amount of gravel used, this having been donated. The average length of haul for surfacing material was  $1\frac{3}{8}$  miles. The total cost of the road was \$2,820.29. Labor was paid for at the rate of \$1.60 per day and teams at \$3.50 per day. There were 5,891 square yards of road surface, which makes the rate per square yard about 48 cents. At this rate the cost of the 9-foot section was about \$2,534 per mile and of the 15-foot section about \$4,224 per mile.

AUBURN, NEBR.—Work on this road was begun August 14, 1905, and was discontinued on account of bad weather November 27, 1905. The work was resumed April 28, 1906, and was completed July 31, 1906. Ten days were lost on account of bad weather. From September 16 to 22, 1905, the road was entirely submerged by floods, causing considerable delay in the work. The character of construction of this road was macadam, the material, limestone, secured from a local quarry. The distance from quarry to crusher was 2,640 feet and the average distance from crusher to road was 1,500 feet. The total length of this road was 3,900 feet. The length of road completed

in 1905 was 2,200 feet, of which 2,000 feet was 14½ feet wide and 200 feet was 15 feet wide; the length of the second section completed in 1906 was 1,700 feet; width, 15 feet. The total thickness of macadam on each section was 10 inches after rolling. A curb 10 inches wide and 12 inches deep was constructed on the upper side of the road throughout its entire length to protect it from flood. On both sides of the road blind ditches were constructed at distances of 100 feet. These were filled with tailings from the crusher. These ditches were so constructed as to drain the subgrade. The road throughout its entire length was built on what is called gumbo or alluvial soil. The total cost of this road was \$9,416.07. The cost of labor was \$1.50 for a ten-hour day; teams, \$3. The total area surfaced was 6,623 square yards, which included 235 square yards of protection. The total cost per square yard was \$1.42, making the rate per mile for a 15-foot roadway \$12,496. The cost of this road may seem exceptionally high. The unusual expense of building the road across a river bottom, necessitating the construction of a heavy curb to protect it from frequent floods, and the laying of the material to a depth of 10 inches consolidated, accounts for the extra cost.

COLUMBIA, Mo.—Work was begun on the road leading west from Columbia, Mo., June 8 and completed September 2, 1905. There were six days too wet for work. The character of construction was macadam, and the material, limestone. The road was built in two courses, 2½-inch stone being used for the foundation course and 1½-inch stone for the surface, with screenings and stone dust for binder. The length of road constructed was 5,253 feet; width of grade, 30 feet; width of macadam, 16 feet; depth rolled, 6 inches. The total amount of excavation was 7,100 cubic yards, which cost 21 cents per cubic yard. The soil was a clay and marl mixed with a large number of stones. Two 12-inch terra-cotta cross drains were placed, one 36 feet long and the other 42 feet. There was 2,847 cubic yards of stone quarried, at 34 cents per cubic yard, and 2,797 cubic yards crushed at 24 cents per cubic yard. The material was secured from a local quarry. The total cost of the road was \$5,094.28. Of this, \$884.94 was paid for labor at quarry, \$813.15 for hauling stone to crusher, \$251.10 for hauling stone from crusher to road, \$359.94 for labor at crusher, \$201.83 for rent of engine to run crusher, \$1,399.02 for excavation, \$142.20 for spreading stone, and \$982.10 for incidentals. The cost of labor was \$1.50 per day and of teams \$3. There was 9,339 square yards of macadam laid, making the total cost per square yard 54 cents, or \$5,120.44 per mile.

MACON, Mo.—This road was begun September 27, 1905, and completed December 10, 1905. Five days were lost on account of bad weather. The character of construction was limestone macadam. The total length of road surfaced was 3,700 feet; width of macadam, 14 feet; depth, rolled, 8 inches. No grading was done except the shaping of the roadbed and the preparation of the shoulders and gutters. The material was procured from a local quarry. The total cost of the road was \$3,229.16, of which \$1,478.39 was paid for 2,217 tons of stone at 66½ cents per ton; \$392.62 for labor at crusher; \$197.87 for hauling stone to road; \$196.92 for spreading stone, and \$276.05 for shaping roadbed and preparing shoulders and gutters, and \$687.31 for incidentals. The cost of labor was \$1.50 per day and of teams \$3. There was 5,756 square yards of macadam laid, making the average cost per square yard 56.1 cents, or \$4,607.67 per mile.

PULLMAN, WASH.—Preliminary grading was begun on an object-lesson road at this place on March 30, 1906, but considerable delay was caused during the month of April on account of bad weather and the surfacing work did not begin until May 3. The road was completed on May 23. The ordinary macadam method of construction was used and the road was built of tough basaltic rock. The total length of road surfaced was 1,478 feet. The width of macadam was 14 feet, and the depth, rolled, varied from 6 to 12 inches. Only 200 feet, however, was 12 inches in depth, and this extra depth of material was placed on account of soft ground. The material was secured from a quarry near the roadside, the average haul for crushed stone being about 800 feet. In order to prevent water from rising under the road it was necessary to lay about 1,000 feet of porous tile on the upper side of the road. This tile was 6 inches in diameter and was laid at an average depth of 2½ feet. The total cost of the road was \$2,927.49. The cost of labor was \$2.50 per day and of teams \$4.50 per day. There was 2,299 square yards of road surfaced, making the average cost per square yard \$1.27, or approximately \$10,458.31 per mile. This would seem to be an unusually high price for a road of this character, but it should be observed that the price paid for labor was exceptionally high.

TEXARKANA, ARK.—Work at this place was begun August 28, 1905, and completed January 13, 1906. Out of 124 working days, 64 were fair, while during the remaining period there were frequent interruptions on account of wet weather. The road was built of chert, gravel, and brickbats. The gravel was secured from a local deposit



and was hauled by wagons about one-half mile. The chert was shipped in by rail from Stilwell, Ind. T., a distance of about 200 miles, and was hauled by wagons about  $1\frac{1}{2}$  miles. The total length of road finished was as follows: Chert surface on brickbat foundation, 200 feet; gravel surface on brickbat foundation, 1,164 feet; gravel roadway, two courses, 1,970 feet; total, 3,334 feet. The width of surfaced roadway was 12 feet, and the average depth, rolled, was 7 inches. In addition to this, 1,000 feet of roadway was graded ready for surfacing. Approximately 9,000 cubic yards of earth was moved. The total cost of the road was \$2,968.99. This was on the basis of labor at \$1.50 per day and teams \$3.50. The chert was paid for at the rate of \$1.10 per cubic yard. There was 4,445 square yards of road surfaced, which makes the rate per square yard 66.8 cents, or \$4,702.02 per mile. This does not include \$423.56, the estimated cost of grading the 1,000 feet not surfaced, nor \$1,261.33 which was expended for building two concrete culverts.

SAN ANTONIO, TEX.—Work at this place was done on a suburban road connecting the improved country roads with the city streets. It was begun June 5 and completed July 28, 1905. The rainy and excessively hot weather which prevailed during the time this road was under way seriously interfered with the work and increased the cost. The character of construction was macadam and the material limestone, which was placed in two layers and compacted to 6 inches. The material was obtained from a local quarry, the average length of haul being  $2\frac{1}{4}$  miles. The length of road completed under our direction was 1,469 feet, having widths of 10, 21, 26, and 39 feet. There was 1,265 cubic yards of excavation. The amount of material crushed was 1,993 cubic yards, of which 568 cubic yards was on hand when the work was completed. The total cost of the road was \$4,398.57, of which \$1,378.07 was paid for quarrying and crushing at approximately 70 cents per cubic yard; \$458.80 for grading, which involved the moving of 1,265 cubic yards of earth; \$712.85 for hauling 1,425 $\frac{3}{4}$  cubic yards of stone at 50 cents per cubic yard; \$195 for spreading rock; \$531.73 for rolling and for hire of roller, machinery, and tools, and repairs to same; \$235 for foreman, timekeeper, and inspector, and \$531.73 for incidentals. The total number of square yards surfaced was 4,478 $\frac{2}{5}$ , making the average cost per square yard 98.1 cents, or \$15,711.70 per mile for a roadway having an average width of 27.4 feet. This does not include the cost of curbing and lowering water and gas mains, making sewer connections, etc., which amounted to \$582.01. These items have been omitted from the total cost on account of the fact that such expenses do not ordinarily occur on country roads. The cost of labor was \$1.50 per day and of teams \$3 per day.

LAFAYETTE, LA.—Work was begun on this road March 7, 1906, and continued until June 20, 1906. A drought of two months interfered seriously with the progress of the work, and eight days' delay occurred on account of rain and other causes. This road was made of oyster and clam shells, the latter being used for the surface. There were 111 cubic yards of clam shells used at 90 cents per cubic yard delivered, and 177 cubic yards of oyster shells at 56 cents. The total length of road graded was 3,800 feet; length surfaced, 600 feet; width of surfaced road, 14 feet; depth of surface material after rolling, 6 inches; approximate amount of excavation, 2,482 cubic yards. Two 21-inch vitrified pipe culverts, each 25 feet long, were laid under an intersecting road in order to discharge the water from the road into a bayou. The approximate cost of the 600 feet surfaced was \$383.50, of which \$184.20 was for labor and \$199.30 for material. The cost of grading, ditching, and preparing the entire section of road, 3,800 feet, exclusive of surfacing, was \$1,169.54. The cost per hour of labor was 10 to 12 $\frac{1}{2}$  cents and of teams 30 cents. There was 982 square yards surfaced, making the cost per square yard approximately 39 cents or \$3,200 per mile.

SNOW HILL, ALA.—Work was begun on the road leading from Snow Hill to Furman, Ala., January 10, 1906, and the road was completed June 5, 1906. There were in all thirty-five days too wet to work. The character of construction was macadam and the material limestone. The foundation consisted of 5 inches of crushed stone above 2 inches in size; the second layer,  $2\frac{1}{2}$  inches thick, was of stone from 1 to 2 inches in size; the third or surface layer consisted of enough screenings (below 1 inch in size) to fill all voids. The total length of the road surfaced was 4,446 feet. The width of grade in cuts was 22 feet and on fills was 24 feet. The width of macadam was 12 feet, and depth after rolling 6 to 7 inches. The average cut made to finished grade was 3.3 feet; the maximum, 7.3 feet. The average fill was 2 feet; the maximum, 4.6 feet. The approximate number of cubic yards of excavation was 4,430. The nature of soil was red clay and vegetable loam. One 24-inch vitrified pipe cross drain, 40 feet long was used. Total amount of surfacing material used was 1,396 cubic yards. The material was secured from a quarry about 100 feet from crusher. The average length of haul for surfacing material was 2,800 feet. A 9-by-15-inch jaw crusher was used, operated by a

15-horsepower traction engine. The average output for ten hours was 70 cubic yards, and the maximum 90 cubic yards. The total cost of the road was \$2,465.53, of which \$783.61 was paid for labor and teams for grading and preparation of foundation, \$1,109.12 for quarrying and crushing stone, and \$572.78 for incidentals. The cost of labor was 75 cents per day, and of teams \$2.25. There was 5,928 square yards surfaced with stone, making the average cost per square yard 41 cents, or \$2,886.40 per mile for a roadway surfaced to a width of 12 feet.

UNIONTOWN, ALA.—This road was begun November 7, 1905, and was finished May 8, 1906. During thirty-four days of the time the weather was too wet for work, and twenty-two days' delay occurred in waiting for material. The character of construction was macadam, and the material used was limestone, chert, slag, clay, and limestone screenings for binder. Two courses were laid; the first course, 5 inches deep, was of stone from 2½ to 4 inches in size, and the second or surface layer varied in size from stone dust to 1½ inches. The total length of road surfaced was 5,500 feet; width of macadam on 1,580 feet of the road, 14 feet, and on 3,920 feet, 12 feet. The depth of surface material after rolling was 6 inches. The approximate number of cubic yards of earth excavated was 1,281.5. Terra cotta cross drains were placed as follows: One 8-inch, two 12-inch, two 15-inch, two 18-inch, and two 24-inch. The total amount of surfacing material used was 1,280½ cubic yards. Some of the material was shipped in and some was obtained from a local quarry. The length of haul for the local stone was 5 miles, and for the foreign material by rail was 175 miles. The soil was mostly stiff clay or clay mixed with sand. The total cost of the road was \$2,677.06, of which \$509.34 was paid for labor and teams in grading and preparation of foundation, \$1,179.96 for material, and \$987.76 for incidentals. Labor cost \$1 per day and teams \$3.50. There was 7,684 square yards surfaced, making the cost 35 cents per square yard, and the rate per mile for the 12-foot section \$2,460, and for the 14-foot section \$2,874.66.

ABBEVILLE, S. C.—This road was begun July 31, 1905, and finished September 13, 1905. Five days' delay occurred on account of an accident to the machinery. The character of construction was macadam, the road having a gravel foundation and chert surface, both of which were secured from local deposits. The average haul by teams and traction engines was 2½ miles. The total length of road surfaced was 1,970 feet, of which 1,170 feet was 18 feet wide and 800 feet was 24 feet wide. The depth of compacted surface was 6 inches. The total cost of construction was \$496, of which \$24.60 was paid for eighty-two days' convict labor, at 30 cents per day. Other labor was paid for at 75 cents per day, and the traction engine for hauling surfacing material cost \$5.50 per day, while teams cost \$2.50 per day. The material cost 7½ cents per cubic yard. There was 4,473½ square yards of road surfaced, making the average cost per square yard 11 cents, or \$1,419.73 per mile for a roadway having an average width of 22 feet.

UNION, S. C.—This road was begun June 2, and completed July 11, 1906. It was constructed according to the macadam method, the material used being granite. The total length surfaced was 1,602 feet, of which 1,347 feet was 40 feet wide and 255 feet was 32 feet wide; depth after rolling, 8 inches. The amount of surfacing material used was 1,884 cubic yards. This material was obtained from a local quarry. The total cost of this road was \$1,671.42. Labor was paid for at the rate of 75 cents per day; teams, \$2.50, and traction engine for hauling stone, \$5 per day. The total area of road surfaced was 6,893½ square yards, making the cost 24.2 cents per square yard, or \$5,494.37 per mile for a roadway having an average width of 38.7 feet.

KENANSVILLE, N. C.—On March 6, 1906, work was begun on the road leading from Kenansville to Magnolia, N. C., and continued until April 17, 1906. Favorable weather prevailed throughout this period. This road was improved according to the sand-clay method, the clay being spread upon the sand subsoil and mixed by plowing and harrowing. The total length of road surfaced was 5,900 feet. The width of surfaced road was 20 feet, and the depth of sand-clay mixture 6 inches. The average cut to finished grade was 4.5 inches; maximum, 12 inches. The average fill made to finished grade was 5 inches; maximum, 12 inches. No special provision had to be made for drainage, as the road was constructed on deep sand throughout its entire length. The amount of surfacing material used was approximately 2,185 cubic yards, which was hauled an average distance of 1,100 feet. The total cost of the road was \$440.35, which was incurred for labor and teams in preparing the roadbed and hauling the material. This is on the basis of 80 cents a day for men and \$1.50 a day for a team without driver. The total area surfaced was 13,111 square yards. This would make the average cost per square yard 3.3 cents, or \$387.18 per mile for a roadway surfaced with the sand-clay mixture 20 feet wide.

KINSTON, N. C.—The work at this place was begun May 10, 1906, and completed the same day. This road was built according to the sand-clay process. The prepared roadbed was surfaced with 4 inches of clay, covered with 3 inches of sand and mixed with a disk harrow. The material was secured near the road. The length of road constructed was 600 feet, and the width 16 feet. The work was done by 23 convicts at 75 cents each per day. A foreman, subforeman, and guards were employed at the rate of \$2, \$1.20, and 90 cents per day, respectively. The price of teams per day was \$2.50. There were 1,066 square yards of road surfaced. The total cost of the road was \$31.45, making an average cost per square yard of 3 cents, or \$276.92 per mile for a 16-foot roadway.

NEWBERN, N. C.—This road was begun May 14 and completed May 16, 1906. The sand-clay method of construction was followed, the clay being secured near the roadside. The materials were spread upon the road to a thickness of from 2 to 3 inches and to a width of 12 feet. The mixing was done by means of a disk harrow. The total length of road surfaced was 800 feet. The total cost was \$28.86, making the cost per square yard 2.7 cents, and the cost per mile approximately \$190.

WASHINGTON, N. C.—Work was begun on an object-lesson road at this place April 24, 1906, and completed May 21, 1906. Fair weather prevailed. The sand-clay method of construction was used, the material being secured from the roadside. The clay was spread to a depth of 8 inches in the center and 4 inches at the sides. The length of road improved was 2,700 feet and the width of sand-clay surface was 14 feet. Approximately 700 cubic yards of surfacing material was used. The total cost of the road was \$375.50. The cost of labor was \$1 per day, and of team without driver, \$1.50. There was 4,200 square yards surfaced, making the total cost per square yard 9 cents, or \$739.13 per mile.

MOUNT WEATHER, VA.—The road at this place was located on the grounds of the United States Weather Bureau. Work was begun on July 19, 1905, and completed October 7, 1905. Fair weather prevailed during this time, with the exception of eight days. The road was built according to the regular macadam method, the material being hornblende schist procured near the road. Concrete curbs were constructed on both sides of the road, with suitable paved gutters, catch basins, and cross drains. The total length of road surfaced was approximately 2,047 feet; the width of macadam varied from 15 to 18 feet; the total depth after rolling was 6 inches. The total cost of this road was \$2,629.81, which does not include the cost of the curbs, catch basins, or brick-paved gutters. The cost per day of labor was at the rate of \$1.50, and of teams, \$3.50. There was 4,783 square yards surfaced, which makes the rate per square yard 56 cents, or per mile, \$5,913.60, for an 18-foot roadway.

SALEM, OREG.—Preliminary grading was begun for an object-lesson road at this place on May 29, 1906. A macadam road is being constructed, the material consisting of a hard and tough variety of basaltic rock. As the work was not completed before the middle of September, 1906, a full report regarding methods and cost of building will be presented in the next annual report.

SEATTLE, WASH.—A section of road is now being constructed under the direction of experts from this Office, on the Van de Vanter road leading from Seattle to Tacoma, Wash. This work was begun May 3, 1906. About 6,700 feet is to be improved. The method of construction is macadam and the average width is 16 feet. The material used is basalt trap, which is being secured about one-half mile from the road. The work was still under way at the end of the fiscal year and will be reported upon fully in the next annual report.

ANNISTON, ALA.—Preliminary work was begun on a road at this place May 14, 1906. The road is being constructed of limestone, according to the macadam method. As this road was not completed before the 1st of August, 1906, a complete report will appear in the annual report for 1907.

CHEVY CHASE, MD.—On June 18, 1906, work was begun on an object-lesson road at Chevy Chase, Md., located on the extension of Connecticut avenue, Washington, D. C. The standard macadam method is being used in this work, the material consisting of a rather poor quality of granite secured from Cleveland Park, D. C., and hauled to Chevy Chase by wagons. This work is still under way, and a full report of it will be included in the next annual report.

#### SPECIAL ADVICE AND INSPECTION.

There are many problems in connection with the improvement of country roads which can be solved by local road officials only through



the advice and information given by an engineer or expert thoroughly familiar with the particular phases of road construction involved. The Office received many requests for the detail of engineers and experts to consult with local road officials and to give such advice as was necessary. As shown by the following reports, advice has been given on road administration, methods of construction, estimates of cost, character of materials to be used, location of roads, and other questions of a similar character.

ALABAMA.—*Demopolis, March 11 and 12, 1906:* An official meeting of the city council, mayor, and business men was held, and advice was given which resulted in a unanimous sentiment to advance the standard of road improvement. It was moved and carried to ask Government cooperation in the building of an object-lesson road. *Bay Minette, February 19, 1906:* An inspection was made for a road at this place, but was reported upon unfavorably on account of local conditions and lack of funds. *Pineapple, May 19, 1906:* Preliminary surveys were made for a macadam road 3,000 feet long by 14 feet wide, leading from the railroad station through a swampy valley to the village of Pineapple. On May 25, 1906, an informal talk was given to a gathering of residents under the auspices of the Pineapple Good Roads Association, in which advice was given relative to the construction of proposed roads.

DELAWARE.—*Wilmington, July 26, 1905:* Advice was given to the State highway commissioner in connection with road improvement in the State of Delaware. On October 21, 1905, advice was given to the State highway commissioner, when work done under the authority of the commissioner was inspected.

DISTRICT OF COLUMBIA.—*Washington, May 15 to 16, 1906:* Survey and inspection were made of driveway on grounds of Bureau of Standards.

FLORIDA.—*Lake City, May 18, 1906:* Advice was given for improving the methods of construction.

IDAHO.—*Moscow, March 22, 1906:* Inspection of  $1\frac{1}{2}$  miles of road leading from Moscow to cemetery. Road materials were inspected, and a blue basalt was found most suitable for the proposed road building.

ILLINOIS.—*Streator, August 9, 1905:* Advice was given concerning proposed improvement of roads; and on August 19, 1905, an inspection was made of one-half mile of road leading from Streator to Bloomington and one-half mile of road intersecting this from the east.

KENTUCKY.—*Lexington, March 2 and 3, 1906:* Oiled roads were inspected and advice given concerning the use of tar on roads.

LOUISIANA.—*Coushatta, January 22, 1906:* Inspection of 5 miles of road. No funds available with which to build object-lesson road. *New Orleans:* Application for assistance was received from the United States Naval Station June 21, 1906. Preliminary inspection was made for road to be constructed of 3,502 tons of oyster shells and 1,761 tons of clam shells. Fifteen thousand dollars was appropriated by Congress for building this road.

MARYLAND.—*Annapolis, February 19, 1906:* Advice was given regarding proposed road legislation. *Baltimore, August 4, 1905:* An investigation was made of wood paving blocks. *Baltimore, November 24, 1905:* Conference was held with State highway officials of Maryland.

MICHIGAN.—*Ann Arbor, May 6 to 8, 1905:* Conference was held with the authorities of the University of Michigan concerning cooperation in instruction in highway engineering. *Lansing, May 8 to 10, 1905:* Conference was held with the governor of Michigan and other officials concerning proposed road improvement in the vicinity of Lansing.

MISSOURI.—*Columbia, November 10, 1905:* Inspection was made of object-lesson road completed September 1, 1905, and advice was given regarding its care. *Edina, April, 1906:* Inspection was made of road proposed for improvement. *Steedman, May 20, 1905:* Inspection was made of road proposed for improvement.

MISSISSIPPI.—*Columbus, December 26, 1905:* Inspection was made to ascertain feasibility of building object-lesson road.

NEW JERSEY.—*Montclair, April 21, 1906:* Macadam roads treated with tar were inspected.

NEW YORK.—*Albany, December 18, 1905:* Conference was had with the State engineer in regard to cooperation in student instruction. *New York, April 16, 1906:* An interview was had with the chief engineer concerning oil on driveways in Central Park. *New York, April 22, 1906:* A conference was held with the superintendent in regard to oiling the speedway. *Smithboro, April 17 to 19, inclusive:* Advice was given on the maintenance of earth roads, with special reference to underdraining, widening, proper ditching, and crowning and dragging after rains. *Long Island City, April 20, 1906:* An interview was had with the chief engineer regarding oil on highways. Also with Mr. Clifford Richardson on the same subject.

NORTH CAROLINA.—*Newbern, May 4 to 8, 1906, inclusive:* Inspected object-lesson roads and advised board of county commissioners. Object-lesson road was begun and instruction given as to procedure. *Kinston, May 8 to 11, 1906, inclusive:* Advice was given in regard to the mixture of sand and clay for a road, 300 feet of sand-clay road was constructed, and examination was made of 10 to 15 miles of road already built and advice given as to the best treatment to be given it. *Mount Gilead, May 31 to June 2, 1906, inclusive:* Advice was given regarding the roads of the locality. About 15 miles of road was examined, local material suitable for road building was pointed out, and advice given as to its use and in regard to the changing of grades.

OREGON.—*Pendleton, May 25, 1906:* Surveys were made for a road near this place. On account of the nature of the soil, which is a fine-grained lava ash, which becomes very dusty during the summer months, it was thought best not to begin work until September.

PENNSYLVANIA.—*Johnstown, June 9, 1906:* Some experimental work in using coal tar, pitch, and slag on roads and sidewalks was inspected. The use of a large-sized aggregate was advised; also coating the heated slag with tar in a mixing machine instead of pouring tar on the loose slag road.

SOUTH CAROLINA.—*Columbia, May 30, 1906:* Sand-clay roads were inspected.

TENNESSEE.—*Bristol, October 27, 1905:* An investigation was made concerning the construction of a road, and estimates of its cost were given. *Huntsville, May, 1905:* A section of road was inspected, with a view to improving it. *Lenoir City, March 27, 1906:* Inspection was made of road material and transportation facilities, and advice was given for contemplated road improvement. The inspection developed the fact that an excellent quality of limestone and novaculite was available for road building.

TEXAS.—*Bellville, October 28, 1905:* Inspection was made of the condition of roads, available road material, cost of labor, etc. *Brenham, August 23, 1905:* Proposed object-lesson road was inspected and advice was given as to local material available for use. *Waxahachie, November 4, 1905:* One and one-half miles of road leading from Waxahachie to the Ellis County farm was inspected. *Denison, November 8, 1905:* Inspection was made of roads and road materials. Samples of limestone were sent in to the laboratory, tested, and found to be suitable for road building. An object-lesson road was desired. *Paris, November 10, 1905:* Three miles of road was inspected.

VIRGINIA.—*Callaway, June 25 to 28, 1906, inclusive:* Over 40 miles of road was viewed, prospective changes were discussed, and advice was given as to the best method of location, grade, construction, and maintenance. *Manassas, March 22, 1906:* Four miles of road, known as "Battlefield road," was inspected and surveyed. *Norfolk, June 12, 1906:* Inspection was made and advice given in regard to the route of proposed boulevard from Norfolk to Jamestown Exposition grounds. *Thoroughfare, March 23, 1906:* Inspection and survey made of one-half mile of road. *Warrenton, April 2, 1906:* An examination was made to determine the feasibility of burning clay for roads.

WISCONSIN.—*Kilbourn, May 10 and 11, 1905:* An inspection was made of roads at this place.

#### LECTURES, ADDRESSES, AND PAPERS.

During the year lectures and addresses were delivered in 14 States—Alabama, Arkansas, District of Columbia, Illinois, Kentucky, Louisiana, Michigan, Missouri, New Jersey, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. Among the subjects covered were road construction and maintenance, highway administration, and road economics and statistics. Scientific and technical papers were read before various associations and societies. The aim of the Office is to

place full information in the hands of persons who are seeking to improve the public roads, to advise with local officials or citizens' organizations on the specific problems confronting them, and to offer suggestions for improvement, wherever possible, in the local systems of road administration.

A brief summary of work of this kind done during the year is given below:

ALABAMA.—Lectures were delivered under the auspices of the State Farmers' Institute at Decatur, February 8, 1906; Tuscaloosa, February 12; Dothan, February 15; Opelika, February 17; Troy, February 19, and Mobile, February 21. The object of these lectures was to familiarize the local road builders with the elementary principles which should be followed in the construction and maintenance of roads, with especial reference to the requirements of the particular localities in question.

ARKANSAS.—*Fort Smith, June 12, 1906*: Lectures before the State Good Roads Association on chert roads.

DISTRICT OF COLUMBIA.—*Washington, December, 1905*: Lecture before the National Geographic Society on the investigative and experimental work of the Office of Public Roads.

ILLINOIS.—*Rochelle, December 5, 1905*: Address at a meeting of the Ogle County Farmers' Institute on the subject of road administration.

KENTUCKY.—*Frankfort, March 1, 1906*: Lecture on road construction before the State Farmers' Institute. This lecture was preceded by an inspection of the roads in the vicinity of Lexington and Frankfort.

LOUISIANA.—Lectures upon road improvement in its relation to the fruit and truck growing industries were delivered under the auspices of the North Louisiana Fruit and Truck Growers' Institute at the following places: Calhoun, February 12, 1906; Farmer-ville, February 14, 1906; Bernice, February 15, 1906; Ruston, February 16, 1906, and Arcadia, February 18, 1906.

MICHIGAN.—*Port Huron, August 9, 1905*: Address at road convention; subject, "County road administration."

MISSOURI.—*New Franklin, April 21, 1906*: Address at road convention under the auspices of the Business Men's Club; subject, "Economics of road construction."

NEW JERSEY.—*Atlantic City, July 1, 1905*: Paper read before the American Society for Advancement of Engineering Education; subject, "Need for systematic instruction in highway engineering in our colleges." *Atlantic City, June 20, 1906*: Report on tests and investigations of road materials read before the American Society for Testing Materials. *Atlantic City, June 21, 1906*: Paper entitled "Notes on the abrasion and hardness tests as applied to road materials," read before the American Society for Testing Materials.

OHIO.—*London, February 3, 1906*: Address on road economics and road organization. *Wilmington, February 5, 1906*: Address on economics of road construction.

TENNESSEE.—*Union City, April 2, 1906*: Inspection of roads and materials for road construction, followed by an address on road improvement.

VIRGINIA.—*Hampton, March, 1906*: Address at a meeting of the county road officials.

WEST VIRGINIA.—*Martinsburg, March 3, 1906*: Address before the county officials and the citizens of Berkeley County on the subject of "A system of road administration and construction for Berkeley County."

A number of addresses and informal talks were delivered in various parts of the country, in addition to those above mentioned, concerning which a detailed report is scarcely necessary.

#### EXPERIMENTAL WORK (FIELD).

During the year 1906 the experimental work of the Office consisted chiefly in the investigation of methods for rendering roads dustless. A series of careful experiments were made at Jackson,



Tenn., during the spring and summer of 1905, in cooperation with the city engineer, to determine the value of coal tar for preventing dust on macadam roads. Tests were also made with crude Texas oil and several grades of its residue on earth and macadam roads. The expense of these experiments was very small, since the tar was donated. The quantity of tar applied per square yard averaged 0.45 gallon, and the cost of labor for applying this quantity of tar was less than 1 cent. After more than seven months, including the winter season of 1905-6, the tarred roads are still in excellent condition. They are hard, smooth, and resemble asphalt, except that they show a more gritty surface. A full description of these experiments is given in Circular No. 47 of this Office.

Additional experiments were conducted during the summer of 1906 on the Potomac River drive in Washington, D. C., in cooperation with the superintendent of buildings and grounds. Crude coal tar similar to that used at Jackson, Tenn., was used in this work. These experiments have been completed too recently to afford any satisfactory data on results of the work at this time. It may be said, however, that the covering is wearing through in many places, on account of the quantity of fine material on the road when it was treated.

The feasibility of using tar to a large extent in the treatment of road surfaces has not yet been determined. Some experiments in France and a few in this country, notably the one at Jackson, Tenn., have given excellent results. In other cases partial or entire failure has followed experiments, and it remains to be determined whether the obstacles to the successful use of this material in surfacing roads can be overcome or whether they are such as to preclude its general adoption as a dust preventive and preservative of macadam roads.

In the experiments with oils at Jackson, Tenn., 7 tank cars of oil, donated by Texas and Louisiana companies, were used, varying from a light crude oil to a heavy residue from the refineries. The cost of labor per square yard in the experiments with crude oil was 5.7 mills on city streets and 3.3 mills on country roads. On the city streets 0.48 gallon of crude oil was applied per square yard, and on country roads 0.38 gallon per square yard. Of the residual oil 0.71 gallon was used per square yard at a cost for labor of 7.8 mills per square yard. More than seven months have elapsed since the work was completed. The light, crude oil has produced little, if any, permanent improvement. The medium "steamer" oil from Texas has given good results. The best results were obtained with the heavier oils applied hot. The road treated with the heaviest oil is entirely dustless, and can be cleaned or swept as well as the tarred road. There is but little noise, even from horses' hoofs.

No additional experiments were carried on during the fiscal year, but investigations were made of experiments with oil on the Speedway and in Central Park, New York, and of experiments with tar on macadam roads at Montclair, N. J.

It has been demonstrated that roads are injured through loss of material which is carried away in the form of dust by rubber-tired vehicles and especially automobiles. The loss of material in this way is a permanent loss to the road and can only be prevented by treating the roads so as to prevent the formation of dust. When it is con-

sidered that many millions of dollars have been expended in the construction of fine systems of roads in various parts of the United States, and especially in the North and East, the importance of preventing the destruction of these roads or of lessening the cost of maintaining them in the manner indicated can readily be understood.

#### STUDENT INSTRUCTION (FIELD).

The plan of appointing graduates in engineering to the position of civil-engineer student, which was explained fully in the last annual report, has proved satisfactory in every particular. Up to June 30, 1906, nine students had been appointed, at \$600 per annum, of which number one has been promoted through various grades to the position of assistant engineer, at \$1,500 per annum. Another student, whose year of graduate instruction expired March 31, 1906, was promoted to the position of junior assistant engineer, at \$900 per annum, and another to a similar position at \$1,000 per annum, effective July 1, 1906, thus leaving six students who have not yet completed the one-year course.

A number of colleges have within recent years established summer schools in road building. At these schools instruction is given in actual road building, together with lectures on highway engineering and including such portions of the regular engineering course as are found suitable. The Office has been called upon for assistance in the preparation of courses of study and for the detail of engineers to give special lectures from time to time. Very little work of this character, however, has been done, owing to the very limited facilities of the Office. This form of cooperation will undoubtedly yield excellent results, and it is well that a start has been made.

#### LABORATORY TESTS AND INVESTIGATIONS.

This division of the work is under the supervision of the Assistant Director, whose principal assistants are a testing engineer, in charge of the physical laboratory; an assistant chemist, in charge of the chemical laboratory, and a petrographer, in charge of rock analyses.

#### PHYSICAL TESTS.

During the year 384 samples were received at the laboratory for routine tests, of which number 273 were samples of rock intended for macadam road building. Of the 273 samples received, about 42 per cent were limestone, 11 per cent dolomite, 10 per cent trap, 8 per cent sandstone, and 8 per cent granite. The remainder were for miscellaneous tests. Two samples of building brick, one of building stone, five of cement, and four of sand were tested at various times during the year for Government building purposes, and also seven samples of paving brick and one of wood paving blocks to be used in street paving. A comparison of this year's work with the record of samples received during the previous years shows that the routine testing has increased about 33 per cent.

Samples of materials were received from States, Territories, and foreign countries as follows: Alabama, 5; Alaska, 1; Arkansas, 9; California, 6; Colorado, 7; Connecticut, 8; Delaware, 4; District of Columbia, 18; Florida, 1; Georgia, 3; Illinois, 4; Indiana, 82; Kansas, 4;

Kentucky, 4; Maine, 5; Maryland, 21; Massachusetts, 14; Michigan, 11; Minnesota, 1; Mississippi, 2; Missouri, 6; Montana, 4; Nebraska, 4; New Hampshire, 2; New Jersey, 27; New Mexico, 4; New York, 28; North Carolina, 10; North Dakota, 1; Ohio, 8; Oregon, 2; Pennsylvania, 76; South Carolina, 4; Tennessee, 6; Texas, 4; Utah, 1; Vermont, 7; Virginia, 29; Washington, 1; West Virginia, 8; Wisconsin, 13; Germany, 1; unidentified, 4.

A significant fact in connection with the laboratory work is that a very large number of samples have been tested, coming from Eastern and Middle States which have not received a great deal of assistance in the form of object-lesson roads. This tends to distribute uniformly the benefit arising from the work of the Office. There is a growing amount of cooperation between the various State geologists and this Office in the preparation of data showing location, character, and suitability for road work of material throughout each State. As an example, the State of Indiana may be cited, the geologist of that State having forwarded many samples to be tested from his State. From the information thus secured he has prepared a bulletin on the road-building resources of Indiana.

#### ANALYTICAL WORK.

Upon the reorganization of the Office arrangements were made for the installation of a suitable chemical laboratory in the new building. This laboratory was especially equipped for the analysis of road materials, and has been actively engaged in a continuance of the work begun by the Division of Tests. The work is conducted by a chemist and assistant chemist and a petrographer.

Chemical analyses of stratified rocks, clays, sands, mortars, cements, concretes, tars, asphalts, and oils, together with petrographic analyses of the crystalline rocks, constitute the routine work of this laboratory. During the past year nearly 400 samples were received by the Office, which were examined microscopically or analyzed, according to the uses for which they were intended.

Work was also done in improving the methods of analysis and classification of road materials and in tabulating the results of the analyses.

#### EXPERIMENTAL WORK (LABORATORY).

During the year an investigation of the decomposition of rock dust under the action of water, with especial reference to the cause and possible improvement of the binding power of road materials, was carried on, and the information so far obtained gives every indication of producing results which will be of value in the construction and improvement of roads. For example, it has been found that by mixing certain rocks of poor binding power under the action of water a much higher binding power results. As the binding or cementing power of rocks is one of the chief factors in the life of a road, the value of this discovery is of obvious importance. In one experiment a limestone which gave a cementing value of 20 and a granite which gave a cementing value of 6 were combined in this way, and the resulting cementing value was 82. A partial report of the investigation has already appeared in Circular No. 38 of the Office, and it will be fully treated in a forthcoming publication.



The work of standardizing an impact test for paving brick is well under way. This work is being done with an impact machine designed and constructed in this Office, and the results obtained so far are very encouraging.

Besides the work already mentioned, methods of asphalt analysis were studied with reference to their standardization, and tests of oils were made in connection with a study of their behavior when used on roads, a progress report of which was published in Circular No. 47.

#### SPECIAL INVESTIGATIONS.

Before the Division of Tests was combined with the Office of Public Road Inquiries to form the Office of Public Roads, several special investigations were undertaken which did not relate directly to roads. These investigations were continued during the past fiscal year in order that definite results might be obtained before the work was dropped.

Owing to the numerous complaints of farmers regarding the rapid deterioration of modern fence wire in comparison with that manufactured in former years, an investigation of the subject was begun with a view to remedying the defect. Farmers' Bulletin No. 239 contains a report of this investigation, which has aroused the interest of manufacturers and has determined some of them to take active steps toward producing a product more resistant to atmospheric erosion.

As the decomposing action of water on finely ground feldspathic rock powders brings the alkalies into solution, the idea of the possible availability as fertilizers of rock powders rich in potash presented itself. Work along this line has now been turned over to various bureaus of the Department for further investigation.

The scarcity of timber in many sections of the country, not only for construction work, but even for fence posts, has in recent years led to a more general use of concrete. This material is admirably adapted for farm purposes, but there seemed to be a general lack of knowledge concerning its preparation and use. After a series of tests and investigations Farmers' Bulletin No. 235 was issued, in October, 1905, giving full information concerning cement, cement mortar, the making of concrete, and the construction of concrete sidewalks, basement floors, driveways, and fence posts.

#### STUDENT INSTRUCTION (LABORATORY).

Each engineer student before being assigned to work in the field is given a thorough course of instruction in the testing laboratory. This work consists in actually making the various tests on road materials and computing the results. The information thus obtained is considered necessary, in connection with road construction, for a thorough understanding of the relations which exist between laboratory tests and the behavior of these materials under traffic.

#### MACHINE SHOP.

The work of the machine shop has been carried on along the same lines as was indicated in the last report. Additional machinery is

being installed from time to time as necessity requires, and the facilities for doing accurate machine work have been much improved in the last year.

A small impact machine for testing the toughness of rocks is now being constructed in the machine shop.

#### INFORMATION.

This division, which has during the past year been engaged in the collection and compilation of statistics regarding mileage of improved and unimproved roads and expenditures for construction and maintenance, is under the direction of a chief of records. The information is secured through county correspondents and State and county officials.

#### ROUTINE COLLECTION AND COMPILATION OF INFORMATION.

The collection and compilation of information on the mileage of improved and unimproved roads, expenditures for road construction and maintenance, and amounts of bond issues for each county in the United States was not completed in the course of the fiscal year 1906 for several reasons. In the first place, the clerical force was entirely too small to dispose of the very large amount of correspondence entailed by the work. In the second place, it has been necessary in many Northern States to secure the information directly from each township. When it is considered that in some of these States there are as many as 1,500 townships, and that a complete report must be secured from each, some idea of the extent of the work may be obtained. In some cases it has been necessary to write from fifteen to twenty letters to one township before an accurate report could be secured. In a few instances the governors of the States and the authorities of the Post-Office Department assisted in securing the requisite data. The results of the investigation were published as rapidly as the information for each State was complete. The scope of this work is shown in the following table, which includes the States completed at the close of the fiscal year:

*Mileage of improved and unimproved roads and expenditures for maintenance of same in 1904.*

State.	Total mileage.	Im- proved with gravel or stone.	Percent- age im- proved.	Total ex- penditures in 1904.
Alabama.....	50,089	1,654	3.4	\$1,576,434.27
Arizona.....	5,987	217	4.0	109,309.43
Arkansas.....	36,445	236	0.7	1,395,342.80
Iowa.....	102,448	1,778	1.7	3,106,607.50
Maine.....	25,528	2,323	9.0	1,472,393.70
Maryland.....	16,773	1,570	9.0	\$73,470.50
New Hampshire.....	15,116	1,293	8.0	\$72,606.35
New Mexico.....	15,326	.....	.....	165,652.56
North Carolina.....	49,763	1,259	2.5	1,358,687.23
Oregon.....	34,258	2,589	7.5	796,375.97
Pennsylvania.....	99,777	2,129	2.1	4,887,265.68
Tennessee.....	48,989	4,285	9.0	1,621,777.15
Virginia.....	51,812	1,600	3.0	687,751.06
Washington.....	31,998	1,976	6.0	1,436,070.19

## DISSEMINATION OF INFORMATION.

In addition to the routine collection and compilation of information, the Division of Records is frequently called upon to make small investigations of a special and temporary nature and to give advice thru correspondence and lectures regarding the economics of highway construction and management. Such information relates principally to cost of road work, methods of building various types of roads, State-aid roads, legislation regarding road management, the value of wide tires, the use of convict labor in road building, cost of wagon transportation, bond issues for road improvement, etc.

## FOREST TRAILS.

During the fall of 1905 the Office cooperated with the Forest Service in securing information to be used in the preparation of a manual on trail making and maintenance. A circular letter was sent out to the public-road correspondents and various officials asking that they describe briefly the best methods of building and maintaining pack and foot trails, giving proper width and maximum grade for each, as well as full information concerning cost per mile of trails of given widths and grades. A number of replies containing information and suggestions of value were received and referred to the Forest Service.

## EXECUTIVE AND ADMINISTRATIVE.

## IMPROVEMENT IN OFFICE METHODS.

The stenographic force has been concentrated in one section under the supervision of the chief clerk. This arrangement secures a uniform distribution of the work, increases the efficiency of each individual stenographer, and makes it possible to dispose of a much greater amount of work than would otherwise result.

The old system of alphabetical filing has been entirely superseded by modern vertical subject files, indexed by names and subjects. This system was introduced during the preceding fiscal year, but has been brought to a high state of efficiency within the last twelve months.

The mailing list, which contained over 10,000 names, was carefully revised and reduced to one-third that number. The publications of the Office were classified according to their subject-matter in four divisions, namely, (1) construction and maintenance, (2) economic and statistical, (3) legislative, and (4) scientific. The mailing list was arranged in four sections to correspond with this classification, thereby avoiding the promiscuous distribution of all classes of publications.

The practice of holding weekly seminars for the discussion of subjects under investigation by the Office, as well as methods of carrying on the work, has proved beneficial. Much interest has been manifested and many suggestions of value have been offered.

## IMPROVEMENT IN FACILITIES.

(a) *Quarters*.—February 1, 1906, a new building, constructed in accordance with plans prepared in this Office, was leased at \$2,000 per annum. Formerly the office work was conducted on the fourth floor in the main building of the Department and the laboratory work in the



basement of the Bureau of Chemistry building. The quarters were absolutely inadequate, and seriously embarrassed the work. The building erected for the Office is a four-story structure, containing a testing laboratory and machine shop on the ground floor, executive and clerical offices on the second floor, library, property room, chemical and petrographical laboratories on the third floor, and drafting room and assistant engineers' offices on the fourth floor.

(b) *Equipment*.—Since the reorganization of the Office a number of engineering instruments have been purchased and sufficient minor equipment to provide, in a measure, for efficient engineering work in connection with the construction of object-lesson and experimental roads. Some equipment has been added to the laboratory. One 10-ton steam roller was leased before the close of the fiscal year and an additional 10-ton steam roller was also leased during the current year. Three 10-ton steam rollers were purchased during the current year, making in all five rollers now available for field work. The road-building machinery, exclusive of steam rollers, is secured from the manufacturer free of charge. It is hoped, however, that in course of time the Government will have absolute control of this machinery by purchase.

(c) *Records and library*.—A full and complete record of all work done by the Office is kept by means of reports regularly submitted by men in charge of field work. In addition to these reports, card records are kept of Government property and a separate record of all road machinery. Also a card record is kept of appointments, promotions, transfers, and other changes in the personnel of the Office. A system of briefing, on a limited scale, is in use of all correspondence relating to object-lesson and rural-delivery work. This is designed to furnish, for instant reference, a compact record of work requested, work promised, and that which has already been undertaken. Plans, profiles, and cross sections, together with a complete report of all work carried on in the field, are kept in the Office.

During the year a reference library has been collected and catalogued. This collection comprises works on engineering, materials of construction, geology, and chemistry, which have a bearing on road building. An index has been filed with the catalogue, containing every procurable reference to the literature of road construction. The library also contains full sets of reports of highway commissions and scientific societies of allied interests and embraces the leading engineering journals of the United States, as well as English, French, and German periodicals devoted to engineering and road construction, and also many publications upon the cement, clay, and brick industries, etc. Several translations of important articles in foreign journals have been made and are in constant use in the library and in correspondence.

Reference lists have been compiled from time to time to answer demands for information upon subjects of special interest in road work, such as the use of tar and oil on highways. An exhaustive bibliography of the entire subject is in preparation, and will probably be issued during the present year.

The large collection of photographs and lantern slides belonging to the Office has been catalogued and made easily available for use in the illustration of magazine articles and lectures.

## OUTLINE OF WORK FOR THE CURRENT YEAR.

At the time the Division of Tests of the Bureau of Chemistry was combined with the Office of Public Road Inquiries to form the Office of Public Roads several special investigations of importance were being conducted by the Division of Tests, which were not directly related to road improvement. It was necessary that these investigations be carried sufficiently far after the reorganization of the Office so that they could be discontinued without serious detriment. During the current year, however, only matters having a direct bearing upon the subject of road improvement throughout the United States are receiving the attention of this Office. Accordingly, the testing of stone for building and other structural purposes, and the special investigation into the corrosion of iron and steel wire fencing mentioned in the report for 1905, will be discontinued.

The scope of the work has been broadened by means of cooperation with the Post-Office Department in the improvement of rural routes, cooperation with the Forest Service to establish wagon roads and trails in forest reserves, cooperation with the Geological Survey in the preparation of road maps to indicate the classes of the roads appearing upon them, and cooperation with the various Government Departments in the improvement of roads on Government reservations. Examples of this joint work are the construction of a road at the naval station at New Orleans under an appropriation for the Navy Department, the macadamizing of a road in the grounds of the Agricultural Department in this city, and a joint experiment with the War Department in the use of tar on the Potomac River drive, also in this city.

The work proposed for this year may be briefly summarized as follows:

## HIGHWAYS.

## OBJECT-LESSON ROADS.

The force of engineers and experts available for this work has been increased by the appointment of additional roller experts and engineer students. The facilities for carrying it on have also been increased by the purchase of three and the lease of two 10-ton steam road rollers.

Object-lesson roads are now being constructed at Benton, La.; New Orleans, La.; Dyersburg, Tenn.; Occoquan, Va.; Washington, D. C.; Chevy Chase, Md.; Paintsville, Ky.; Oswego, Kans.; Salem, Oreg., and Mount Gilead, N. C. A large number of applications are on file for assistance of this kind.

## LECTURES, ADDRESSES, AND PAPERS.

Under this head are included all lectures and addresses delivered at conventions, farmers' institutes, meetings of road officials, boards of trade, and bodies of a similar character. It has been found to be expensive and unsatisfactory to continue, to any great extent, the practice of withdrawing engineers from construction work in the field to deliver lectures and addresses. The plan of appointing consulting engineers and special agents from among the leading highway engineers of the country for special assignments on a per diem basis is gradually being put into effect, thus allowing the engineers and

experts to continue without interruption work on object-lesson roads to which they have been assigned, or to continue their routine experimental work.

#### STUDENT INSTRUCTION.

It is intended that an examination shall be held early in the spring of 1907 for the purpose of establishing a register of eligibles for appointment to the position of engineer student, so that addition may be made to the present number of students. As a result of this examination it is hoped that at least six or eight appointments may be made. The usual course will be followed in the instruction given, but as the object-lesson and experimental work of the Office is gradually broadening in its scope, the opportunities given these students will be greater than were possible to the students first appointed under this plan.

It is hoped that some means may be found by which the Office will be enabled to comply with a larger percentage of the requests from road schools for the detail of engineers to deliver lectures on highway engineering. These schools are being organized in various parts of the country under the auspices of the State highway commissions and agricultural and engineering schools. A series of lectures on highway engineering at colleges located in various sections of the country would supplement the plan of student instruction in an admirable manner.

#### EXPERIMENTAL WORK.

The introduction of sand-clay roads into the various sections of the country where they may be successfully constructed at moderate cost will be continued during the current year as far as practicable.

No plans have yet been made for additional experiments with burnt-clay roads, but it is probable that further work of this character will be undertaken.

Special attention is being devoted to the investigation of the use of oil, tar, and other bituminous binders for treating the surface of roadways. A number of experiments in the use of tar have already been begun in the city of Washington.

A special study of road machinery will be undertaken to determine the suitability of various types of machinery for different kinds of road work.

#### COOPERATION WITH THE POST-OFFICE DEPARTMENT.

The work of facilitating the rural delivery of mails, by the improvement of country roads, in cooperation with the Post-Office Department is of such vital importance as to merit a full explanation. The plan which carries the approval of the Secretary of Agriculture, under date of July 3, 1906, and of the Postmaster-General, under date of July 10, 1906, provides that whenever a road upon which a rural route has been or is about to be established is reported by the carrier or inspector to be impassable or in bad repair the Fourth Assistant Postmaster-General will advise the Director of the Office of Public Roads of the fact and request that he have an engineer inspector detailed to examine the road and give such advice and instruction to the local officials as may be required.

Upon receipt of such information from the Fourth Assistant Postmaster-General the Director of the Office of Public Roads will com-



municate with the local officials and supply them with a copy of the circular of instructions and a blank form for making application for the detail of such engineer inspector.

It is not the purpose of this Office to actually construct the road or to make any contribution either in money, materials, or labor. In most cases a road is impassable on account of defects which can be remedied by the use of proper methods. The engineer inspector who examines the road will note carefully all such defects and advise as to what steps can be taken to place the road in proper condition without great expense. If practicable and if so desired he may in some cases assume temporary direction of the work for the purpose of instruction.

The limited force of engineers and the small appropriation available for this work make it impossible to comply with a very large percentage of the requests received. No assurance can therefore be given that all applications will be promptly and favorably acted upon.

As the chief aim and purpose of this Office is to bring about a general and uniform improvement of the country roads throughout the United States, a cooperative plan such as the one described above offers the best possible means of achieving positive results in furtherance of that purpose. By this means correct methods of road building and road maintenance will be introduced into practically every section of the United States. The engineer inspectors assigned to this work will, in visiting places which have requested assistance of this character, follow an itinerary which will include a number of places in a given territory. This will greatly minimize the expense of each inspection and permit the inspector to cover a much larger territory than would be possible on a special assignment for each place. A beginning has been made during the current fiscal year and efforts will be made to increase the scope of the work in the future.

#### COOPERATION WITH THE FOREST SERVICE.

Cooperation with the Forest Service in laying out and constructing wagon roads and trails in forest reserves to facilitate lumbering has already been instituted. Thus far only one engineer has been detailed to this work for a short period in the Yellowstone Reserve. This cooperation must necessarily be on a limited scale until sufficient funds are available.

#### COOPERATION WITH THE GEOLOGICAL SURVEY.

Cooperation with the Geological Survey for the purpose of indicating various classes of roads on topographic maps issued by the Survey can only be conducted on a small scale during the present year, owing to lack of adequate appropriation.

#### LABORATORY TESTS AND INVESTIGATIONS.

The following projects will comprise the principal work of the laboratory, aside from the routine physical and chemical tests, the instruction of civil engineer students, and the machine designing and other work of the machine shop:

- (1) Standardization of tests and specifications for paving bricks.
- (2) Improvement of tests for macadam road materials.

(3) Standardization of methods of analysis of asphalts, oils, and other bitumens used in road and street construction.

(4) Physical investigations and tests of bituminous road-binding materials.

(5) Research on the decomposition of rock powders.

(6) Investigations of clays for the manufacture of paving brick and for burnt-clay roads.

(7) In cooperation with the Forest Service, the testing of wood blocks for pavements.

(8) Investigations of materials for the prevention of dust on roads.

(9) Investigation of the constitution of Portland cement and the chemical reactions which take place in the setting of cements.

#### INFORMATION.

##### ROUTINE COLLECTION AND COMPILATION OF INFORMATION.

During the current year the statistics showing expenditures for road improvement in the various States and counties, the mileage of improved and unimproved roads, and the amount of bond issues for 1904 will be completed.

The census of mileage and expenditures now being taken forms the basis for a supplementary investigation regarding methods and cost of road building in various parts of the country. This work will probably be undertaken during the current year, but it is not likely that it will be completed before the next fiscal year. The statement of expenditures in the various States, as shown by the present investigation, will indicate in what counties improved roads are being constructed. This will obviate the necessity of considering each county in the United States, as was the case in the first work of this Division, and it will not be necessary to address inquiries to counties in which no expenditures for improved roads are reported.

#### PUBLICATIONS.

Two Farmers' Bulletins were published during the year, one upon the preparation and use of cement mortar and concrete for farm purposes and another upon the corrosion of steel fence wire. A circular containing the results of experiments with tar and oil, made by the Office at Jackson, Tenn., was also issued.

Recent results of studies upon the decomposition of rock under the action of water were embodied in a circular upon the subject and published during the year. The results of further studies by Dr. A. S. Cushman and Mr. Prevost Hubbard upon the decomposition of the feldspars will be published later. In this work the study of the action of water on ground feldspar will be reviewed and the results of investigations set forth, which will throw much light on the decomposition of rock powders and also on the binding power of macadam road materials.

Mr. Archer B. Hulbert, expert in the Office, has finished a history of roads and road building in the United States which will shortly be published. A bibliography of road literature is now in preparation.

A bulletin upon the construction of sand-clay and burnt-clay roads, by Mr. W. L. Spoon, has recently been issued. This publication will

undoubtedly be of usefulness in those sections of the country where sand and clay are the only available materials for road construction.

Fourteen of the series of circulars giving mileage of improved and unimproved roads and the expenditure of road funds in every county in the United States have appeared. When the series is completed the information will be compiled in a bulletin.

A digest of the road laws of the various States and Territories, Philippine Islands, Hawaii, and Porto Rico is in course of preparation by Mr. J. E. Pennybacker. Mr. Pennybacker is also making a study of the growth and development of road legislation and an analysis of the existing laws on the subject.

There is great need of a bulletin upon macadam road construction, and it is hoped that this can be completed during the year by Mr. A. B. Fletcher, special agent, who has been intrusted with its preparation.

A bulletin on the testing of road materials is in course of preparation.

### EXPENDITURES.

#### *Appropriations and expenditures for the fiscal year ended June 30, 1906.*

Appropriation for statutory salaries.....	\$12, 340	
Lump-fund appropriation.....	37, 660	
Total .....		50, 000
Total amount expended for salaries on statutory roll.....	\$12, 300. 00*	
Lump-fund salaries in Washington, approximately.....	12, 200. 00	
Lump-fund salaries outside of Washington.....	14, 116. 49	
Traveling expenses.....	4, 300. 00	
Stationery, including typewriters.....	743. 23	
Furniture purchased for the equipment of the building erected for the use of this Office.....	577. 90	
Miscellaneous supplies and services, equipment, books, apparatus, machinery, and laboratory materials of all kinds.....	3, 384. 72	
Lease of building.....	596. 00	
Lease of 10-ton steam road roller, at \$196 per annum, for the month of June, 1906.....	16. 33	
Miscellaneous expenses for freight, express, telegraph, telephone, gas, electricity, and station and field expenses.....	1, 200. 00	
Total expenditures.....	49, 434. 67	
Balance unused.....	565. 33	
		50, 000

There are a few accounts yet outstanding and in one or two cases the liabilities have not been definitely ascertained. A final report may show some changes in these figures, and it is probable that the balance of the appropriation to be returned to the Treasury will be somewhat greater than that shown in the statement.

### CLASSIFIED EXPENDITURES.

Owing to the character of the work carried on by this Office, it is impracticable to restrict employees to a single project for any considerable length of time. For instance, an engineer may be in charge of object-lesson road work and during that assignment may participate in the student-instruction project by giving instruction to a student assigned to the particular road under his charge and may also be



detailed temporarily to give special advice at some place situated near his regular assignment. The expenditures for the various kinds of work can therefore only be approximated as follows:

Object-lesson roads.....	\$17, 000
Lectures, addresses, and papers.....	2, 000
Special advice and inspection.....	2, 800
Student instruction.....	3, 000
Field experiments in connection with sand-clay, burnt-clay, tarred, and oiled roads.....	1, 800
Testing of road materials.....	5, 500
Laboratory experiments with oils, tar, and other bituminous binders and burnt clay, also an investigation concerning the binding power of road materials, with special experiments in mixing of different rocks to increase the cementing value.....	1, 500
Special laboratory investigations relating to cement mortar and concrete, and the corrosion of steel fence wire.....	800
Machine designs and general repair work.....	2, 200
Collection and compilation of information.....	5, 300
Special work on historical, bibliographic, and legislative bulletins.....	1, 500
Balance of appropriation devoted to miscellaneous and contingent.....	6, 600
Total.....	50, 000

#### PLANS AND RECOMMENDATIONS FOR 1908.

While the object-lesson method has been in use for some time by this Office, it is hoped that by the next fiscal year the effectiveness of this branch of the work may be increased by emphasizing the educational part of the work and increasing the mechanical facilities. To do this it will be necessary for the Government to own the road machinery and have such transportation facilities as to permit an accurate schedule to be followed in carrying on work at different places. A plan will then be put into operation by which all of the road overseers in a given county will participate in the object-lesson work at stated times and a series of practical lectures setting forth the elementary principles governing road construction, as applied to the particular locality in question, will be delivered during the construction of each object-lesson road. The estimates, however, only call for two additional road experts and two roller operators with a corresponding increase for their subsistence and traveling expenses and a slight increase for maintenance of machinery. Machinery will gradually be purchased as funds are made available.

An estimate is made for eight additional engineer students. The benefits both to the Government and to the individual student, as explained elsewhere in the report, are so decided as to justify increasing the scope of the work as far as possible. The Government receives the services of bright, intelligent young men at nominal salaries for the first year, while the students are receiving such valuable special instruction in highway engineering as to fit them for important positions as highway engineers. Furthermore, by this method of instruction, in the course of a few years the Department will have in its employ a corps of trained and efficient highway engineers.

The work of the coming year will be a continuation of that already begun, with the investigation of new problems as they are presented. One of the most important subjects which will be studied in the near future is the preparation and relative effects of different substances to be used in sprinkling streets and roads for the purpose of laying

dust. As the problem of retaining the dust on certain classes of roads is of vital importance, owing to the destructive effect of automobile traffic, this phase of the work demands thorough investigation. If the results of these experiments are only slightly beneficial in prolonging the life of a macadam road, the estimate of \$4,000 will be saved many times over.

Laboratory testing of road materials has increased fully 100 per cent in recent years and an increase of the staff is necessary in order to meet the requirements. Special investigations are also being made of bituminous binders, the standardization of tests, classification of road materials, the combination of road materials to increase cementing value, and other work of a special nature. A small increase in the appropriation has been recommended in order to provide for the normal growth of this work.





## REPORT OF THE APPOINTMENT CLERK.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE APPOINTMENT CLERK,  
*Washington, D. C., October 15, 1906.*

SIR: I have the honor to submit herewith my annual report respecting the officers, employees, etc., constituting the body of the United States Department of Agriculture as it existed on July 1, 1906, and various addenda relating thereto.

Very respectfully,

J. B. BENNETT,  
*Appointment Clerk.*

Hon. JAMES WILSON, *Secretary.*

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### OFFICERS AND EMPLOYEES.

In the following tables are shown the number of officers and employees in the United States Department of Agriculture appointed, removed, and who died during the fiscal year beginning July 1, 1905, and terminating with June 30, 1906, and the distribution of the officers and employees among the various bureaus, divisions, and offices thereof on July 1, 1906.

*Summary of appointments of persons and changes affecting employees in the United States Department of Agriculture during the fiscal year ended June 30, 1906.*

#### IN THE CLASSIFIED CIVIL SERVICE.

Number of persons appointed from the eligible registers of the Civil Service Commission for a probationary period of six months.....	764
Number of persons given absolute appointments who have satisfactorily served during their probationary appointment of six months.....	480
Number of reinstatements of persons who have resigned, etc., from the service of the Department and been restored to its rolls within one year from the date of their retirement therefrom.....	26
Number of transfers of persons within the Department from subclerical to clerical and higher grades.....	37
Number of persons within the Department transferred from the classified laborer grade to higher grades of classified positions according to act of Congress approved June 30, 1906.....	198
Number of transfers from other Departments of the United States Government to the United States Department of Agriculture.....	38
Number of promotions in salary and class of persons in the Department.....	917
Number of reductions in salary and class of persons in the Department.....	99
Number of temporary and emergency appointments for periods of six months or less in Washington, D. C.....	178

Number of temporary and emergency appointments for periods of six months or less in the forests and fields and on stations outside of Washington, D. C.	445
Number of persons who failed to accept positions.....	51
Number of persons who resigned their positions in the Department.....	403
Number of persons whose appointments were terminated by order of the Secretary of Agriculture .....	335
Number of persons who were removed from the service of the Department by order of the Secretary of Agriculture.....	56
Number of persons who died while in the service of the Department .....	27
Number of persons appointed to positions excepted from civil-service examination in Washington, D. C. ....	14
Number of persons appointed to positions excepted from civil-service examination in the forests and fields and on stations, whose appointments were for very temporary periods, outside of Washington, D. C. ....	665
Number of persons whose appointments to positions excepted from civil-service examination have been terminated.....	279
Total number .....	5,012

*Summary of appointments of persons and changes affecting employees in the United States Department of Agriculture during the fiscal year ended June 30, 1906.*

#### IN THE UNCLASSIFIED SERVICE.

Number of appointments in the unclassified service in Washington, D. C.....	74
Number of separations, including resignations, terminations of appointments, and removals in Washington, D. C .....	77
Number of persons who died while in the unclassified service in Washington, D. C. ....	1
Number of unclassified-service appointments, being laborers, in the forests and fields and on stations outside of Washington, D. C., whose appointments were for very temporary periods, in the great majority of cases averaging not more than three months .....	1,539
Total number .....	1,691
Total number of actions respecting persons in the classified civil service.....	5,012
Total number of actions respecting persons in the unclassified service .....	1,691
Total number .....	6,703

*Number of persons employed in the different bureaus, divisions, and offices on July 1, 1906, showing the number employed outside of Washington, D. C., and the number employed in Washington, D. C., and the totals thereof.*

Bureau, Division, or Office.	Number of employees.		
	Outside of Washington, D. C.	In Washington, D. C.	Total.
Office of the Secretary.....	1	111	112
Weather Bureau.....	a 1,625	186	1,811
Bureau of Animal Industry .....	1,326	129	1,455
Bureau of Plant Industry .....	216	357	573
Forest Service.....	1,170	220	1,390
Bureau of Chemistry .....	26	84	110
Bureau of Soils .....	60	73	133
Bureau of Statistics .....	60	90	150
Bureau of Entomology.....	48	43	91
Bureau of Biological Survey.....	7	24	31
Division of Accounts and Disbursements.....		23	23
Division of Publications.....		166	166
Library.....		16	16
Office of Experiment Stations.....	86	50	136
Office of Public Roads.....	23	22	45
Total .....	4,648	1,594	6,242

a Of these, 64 are employed regularly at various times during the year and 110 are employed occasionally; but none of these 174 were employed on July 1, 1906.

During the year ended June 30, 1906, there were recorded 28 deaths among the officers and employees of the Department—10 in Washington and 18 outside of Washington—as shown in the following table:

*Separations, by death, from the Department during the fiscal year ended June 30, 1906.*

Name.	State.	Position.	Bureau, Division, or Office.	Salary.	Date of death.	Age.
Louis A. Hatten.....	Mo...	Assistant observer..	Weather Bureau.....	\$840.00	1905. July 4	27
Wm. F. Hubbard.....	D.C...	Forest assistant.....	Forest Service.....	1,300.00	July 17	28
Ralph A. Martin.....	Conn.	Agent and expert...	Office of Experiment Stations.	a 50.00	July 30	33
Russell G. Merrill.....	Nebr.	Stock examiner....	Bureau of Animal Industry.	900.00	July 31	59
Reynolds Hill.....	Ohio.	Forest agent.....	Forest Service.....	200.00	Aug. 2	30
Jacob K. Skinner.....	Kans.	Clerk.....	Bureau of Animal Industry.	900.00	Aug. 6	67
Chas. E. Baker.....	N.Mex	Deputy forest ranger.	Forest Service.....	900.00	Aug. 31	40
Geo. T. Williams.....	Tex..	Special agent.....	Bureau of Plant Industry.	a 80.00	Sept. 15	46
Harry B. Wren.....	Wyo..	Observer.....	Weather Bureau.....	1,300.00	Oct. 1	37
Bennett Banks.....	Va....	Unskilled laborer...	Bureau of Soils.....	600.00	Oct. 6	36
John A. Bell.....	N. Y..	Inspector.....	Bureau of Animal Industry.	b 8.00	Oct. 10	49
Sylvester D. Judd.....	N. Y..	Assistant biologist..	Bureau of Biological Survey.	1,400.00	Oct. 22	35
Wm. J. Keleher.....	Mo...	Tagger.....	Bureau of Animal Industry.	720.00	Nov. 15	32
Wallace L. Payne.....	Idaho.	Forest guard.....	Forest Service.....	720.00	Nov. 24	21
Joshua Carey.....	D.C...	Foreman.....	Weather Bureau.....	720.00	Dec. 10	55
Nathaniel Shatswell..	Mass.	Messenger.....	Office of Secretary...	840.00	Dec. 14	71
Wm. C. Pennywitt.....	Ill...	.....do.....	.....do.....	840.00	Dec. 27	66
P. L. Hutchinson.....	La....	Special field agent..	Bureau of Statistics...	2,250.00	1906. Jan. 2	36
Geo. F. Thompson.....	Kans.	Editor.....	Bureau of Animal Industry.	2,000.00	Jan. 6	45
Thos. B. Baldwin.....	Iowa.	Special field agent..	Bureau of Statistics...	b 7.00	Jan. 12	50
Percy L. Huntley.....	N. Y..	Messenger boy.....	Weather Bureau.....	360.00	Feb. 15	16
Wm. Halley.....	D.C...	Carpenter.....	Bureau of Plant Industry.	b 3.50	Mar. 16	54
Wells W. Miller.....	Ohio.	State statistical agt.	Bureau of Statistics...	800.00	Apr. 7	64
Reinhold F. de Grain.	D.C...	Clerk.....	Weather Bureau.....	1,200.00	Apr. 25	65
Geo. C. Boland.....	S.Dak	Deputy forest ranger.	Forest Service.....	900.00	Apr. 26	58
John R. Glenn.....	Ga....	Messenger.....	Weather Bureau.....	480.00	May 11	25
Orin Douglas.....	.....	Expert in dairying..	Bureau of Animal Industry.	b 5.00	June 4	70
Howard Cleveland....	S.Dak	Messenger boy.....	Weather Bureau.....	480.00	June 27	17

## RECAPITULATION.

	Classified.	Unclassified.	Excepted.	Total.
Washington.....	9	1	.....	10
Outside.....	11	.....	7	18
Total.....	.....	.....	.....	28

a Per month.

b Per day.

## LIST OF PRINCIPAL OFFICERS IN THE SEVERAL BUREAUS, OFFICES, AND DIVISIONS IN THE DEPARTMENT OF AGRICULTURE.

## OFFICE OF THE SECRETARY.

JAMES WILSON, confirmed Secretary of Agriculture March 5, 1897.

Assistant Secretary—Willet M. Hays.

Chief Clerk—Sylvester R. Burch.

Solicitor—George P. McCabe.

Appointment Clerk—Joseph B. Bennett.



Private Secretary to the Secretary of Agriculture—Jasper Wilson.  
 Private Secretary to the Assistant Secretary of Agriculture—H. H. Mowry.  
 Chief of Supply Division—Cyrus B. Lower.  
 Engineer and Captain of the Watch—Lewis Jones.

## WEATHER BUREAU.

[Corner Twenty-fourth and M streets. Phone West 74.]

Chief—Willis L. Moore.  
 Assistant Chief—Henry E. Williams.  
 Chief Clerk—Daniel J. Carroll.  
 Editor of Monthly Weather Review—Prof. Cleveland Abbe.  
 In Charge of Division of Meteorological Records—Prof. Frank H. Bigelow.  
 In Charge of Instrument Division—Prof. Charles F. Marvin.  
 In Charge of Forecast Division—Prof. Edward B. Garriott.  
 In Charge of Special Research and Forecaster—Prof. Alfred J. Henry.  
 In Charge of River and Flood Service and Forecaster—Prof. Harry C. Frankenfield.  
 In Charge of Weather Bureau accounts—Edgar B. Calvert.  
 Chiefs of Division:  
   Climatological—James Berry.  
   Publications—John P. Church.  
   Telegraph—Jesse H. Robinson.  
   Ocean Meteorology—James Page.  
   Supplies—Frank M. Cleaver.  
 Librarian—Herbert H. Kimball.  
 In Charge of Forecast Districts:  
   Prof. Henry J. Cox, Chicago, Ill.  
   Prof. Alexander G. McAdie, San Francisco, Cal.  
   District Forecaster, John W. Smith, Boston, Mass.  
   District Forecaster, Edward A. Beals, Portland, Oreg.  
   District Forecaster, Isaac M. Cline, New Orleans, La.  
   District Forecaster, Frederick H. Brandenburg, Denver, Colo.  
   District Forecaster, Ferdinand J. Walz, Louisville, Ky.  
 Inspectors:  
   Norman B. Conger, Detroit, Mich.  
   Henry B. Hersey, Milwaukee, Wis.  
 Research Staff, Mount Weather, Va.:  
   Supervising director—Prof. William J. Humphreys.  
   Director of upper air research—Dr. Oliver L. Fassig.  
   Director of magnetic research—Eric R. Miller.  
   Research observers—Dr. Cleveland Abbe, jr., William R. Blair.  
   Observer in charge of property—Charles S. Wood.

## BUREAU OF ANIMAL INDUSTRY.

Chief—Alonzo D. Melvin.  
 Assistant Chief—A. M. Farrington.  
 Chief Clerk—Edward B. Jones.  
 Chief of Dairy Division—Ed H. Webster.  
 Assistant Chief of Dairy Division—Clarence B. Lane.  
 Chief of Inspection Division—R. P. Steddum.  
 Associate Chief of Inspection Division—U. G. Houck.  
 Assistant Chief of Inspection Division—Morris Wooden.  
 Chief of Quarantine Division—Richard W. Hickman.  
 Editor—James M. Pickens.  
 Animal Husbandman—George M. Rommel.  
 Librarian—Beatrice C. Oberly.

*Laboratory.*

Chief of Biochemic Division—Marion Dorset.  
 Chief of Pathological Division—John R. Mohler.  
 Chief of Zoological Division—B. H. Ransom.

*Experiment Station.*

Superintendent—E. C. Schroeder.  
 Expert Assistant—W. E. Cotton.

## BUREAU OF PLANT INDUSTRY.

Pathologist and Physiologist, and Chief of Bureau—Beverly T. Galloway.  
 Pathologist and Physiologist, and Assistant Chief of Bureau—Albert F. Woods.  
 Chief Clerk—James E. Jones.  
 Editor—J. E. Rockwell.  
 Laboratory of Plant Pathology—Erwin F. Smith, Pathologist in charge.  
 Investigations of Diseases of Fruits—Merton B. Waite, Pathologist in charge.  
 Plant Breeding Investigations—Herbert J. Webber, Physiologist in charge.  
 Plant Life History Investigations—Walter T. Swingle, Physiologist in charge.  
 Soil Bacteriology and Water Purification Investigations—Karl F. Kellerman, Physiologist in charge.  
 Bionomic Investigations of Tropical and Subtropical Plants—Orator F. Cook, Bionomist in charge.  
 Drug and Poisonous Plant Investigations and Tea Culture Investigations—Rodney H. True, Physiologist in charge.  
 Physical Laboratory—Lyman J. Briggs, Physicist in charge.  
 Taxonomic Investigations—Frederick V. Coville, Botanist in charge.  
 Farm Management Investigations—William J. Spillman, Agriculturist in charge.  
 Grain Investigations—Mark A. Carleton, Cerealists in charge.  
 Arlington Experimental Farm—Lee C. Corbett, Horticulturist in charge.  
 Sugar Beet Investigations—Charles O. Townsend, Pathologist in charge.  
 Western Agricultural Extension—Carl S. Scofield, Agriculturist in charge.  
 Dry Land Agriculture—E. Channing Chilcott, Expert in charge.  
 Pomological Collections—Gustavus B. Brackett, Pomologist in charge.  
 Field Investigations in Pomology—William A. Taylor and G. Harold Powell, Pomologists in charge.  
 Experimental Gardens and Grounds—Edward M. Byrnes, Superintendent.  
 Seed and Plant Introduction and Distribution—David G. Fairchild, Agricultural Explorer in charge.  
 Seed Laboratory—Edgar Brown, Botanist in charge.  
 Mississippi Valley Laboratory—Hermann von Schrenk, Expert in charge, St. Louis, Mo.  
 Subtropical Laboratory and Gardens—Ernst A. Bessey, Pathologist in charge, Miami, Fla.  
 Plant Introduction Garden—Palemon H. Dorsett, Pathologist in charge, Chico, Cal.  
 Cotton Culture Farms—Seaman A. Knapp, Special Agent in charge, Lake Charles, La.

## FOREST SERVICE.

Forester and Chief—Gifford Pinchot.  
 Associate Forester—Overton W. Price.  
 Assistant Forester in Charge of Inspection—Frederick E. Olmsted.  
 Assistant Forester in Charge of Forest Management—Thomas H. Sherrard.  
 Assistant Forester in Charge of Dendrology—George B. Sudworth.  
 Assistant Forester in Charge of Forest Extension—Ernest A. Sterling.  
 Assistant Forester in Charge of Forest Products—William L. Hall.  
 Assistant Forester in Charge of Records—James B. Adams.

## BUREAU OF CHEMISTRY.

Chemist and Chief—Harvey W. Wiley.  
 Division of Foods—Willard D. Bigelow.  
 Sugar Laboratory—C. A. Browne, jr.  
 Dairy Laboratory—G. E. Patrick.  
 Plant Analysis Laboratory—C. C. Moore.  
 Miscellaneous Laboratory—John K. Haywood.  
 Drug Laboratory—Lyman F. Kebler.  
 Contracts Laboratory—P. H. Walker.  
 Microchemical Laboratory—B. J. Howard.  
 Leather and Paper Laboratory—F. P. Veitch.  
 Chief Clerk—M. T. Read.

## BUREAU OF SOILS.

Soil Physicist and Chief of Bureau—Milton Whitney.  
 Chief Clerk—A. G. Rice.  
 Soil Chemist—Frank K. Cameron.

In Charge of Soil Management—Frank D. Gardner.  
 In Charge of Soil Survey Work—Jay A. Bonsteel.  
 In Charge of Alkali Reclamation Investigations—Clarence W. Dorsey.  
 In Charge of Tobacco Investigations—George T. McNess.  
 In Charge of Soil Fertility Investigations—Oswald Schreiner.

## BUREAU OF STATISTICS.

Statistician and Chief—Victor H. Olmsted.  
 Assistant Statistician and Assistant Chief—C. C. Clark.  
 Chief Clerk—Elmer J. Lundy.  
 Chief of Division of Foreign Markets—George K. Holmes; Assistant Chief,  
 Frank R. Rutter.  
 Editorial Assistant and Special European Agent—C. M. Daugherty, London,  
 England.

## BUREAU OF ENTOMOLOGY.

Entomologist and Chief—L. O. Howard.  
 Entomologist and Acting Chief in absence of Chief—C. L. Marlatt.  
 Chief Clerk—R. S. Clifton.  
 In Charge of Breeding Experiments—F. H. Chittenden.  
 In Charge of Forest Insect Investigations—A. D. Hopkins.  
 In Charge of Cotton Boll Weevil Investigations—W. D. Hunter.  
 In Charge of Cereal and Forage Plant Insect Investigations—F. M. Webster.  
 In Charge of Deciduous Fruit Insect Investigations—A. L. Quaintance.  
 In Charge of Apicultural Investigations (Acting)—E. F. Phillips.

## BUREAU OF BIOLOGICAL SURVEY.

Biologist and Chief—C. Hart Merriam.  
 Administrative Assistant, Acting Chief in absence of Chief—H. W. Henshaw.  
 Assistant in Charge Economic Investigations—A. K. Fisher.  
 Assistant in Charge Game Preservation—T. S. Palmer.  
 Assistant in Charge Geographic Distribution—Vernon Bailey.

## OFFICE OF EXPERIMENT STATIONS.

Director—A. C. True.  
 Assistant Director and Editor of Experiment Station Record—E. W. Allen.  
 Editorial Staff:  
 Meteorology, Soils, and Fertilizers—W. H. Beal.  
 Agricultural Botany and Vegetable Pathology—Walter H. Evans.  
 Field Crops—J. I. Schulte.  
 Horticulture and Forestry—C. B. Smith.  
 Zootechny and Human Nutrition—C. F. Langworthy.  
 Agrotechny, Dairy Farming, and Dairying—H. W. Lawson.  
 Economic Zoology, Entomology, and Veterinary Medicine—E. V. Wilcox.  
 Rural Engineering—B. P. Fleming.  
 Rural Economics—J. B. Morman.  
 Agricultural Education—D. J. Crosby.  
 Chief of Editorial Division—W. H. Beal.  
 Chief of Division of Insular Stations—Walter H. Evans.  
 In Charge of Alaska Experiment Stations—C. C. Georgeson, Sitka.  
 In Charge of Hawaii Experiment Station—J. G. Smith, Honolulu.  
 In Charge of Porto Rico Experiment Station—David W. May, Mayaguez.  
 Chief of Nutrition Investigations—C. F. Langworthy.  
 In Charge of Respiration Calorimeter Investigations—F. G. Benedict, Middletown,  
 Conn.  
 Chief of Irrigation and Drainage Investigations—Elwood Mead.  
 In Charge of Drainage Investigations—C. G. Elliott.  
 Farmers' Institute Specialist—John Hamilton.  
 Chief Clerk—Mrs. C. E. Johnston.

## DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Chief and Disbursing Clerk—Almerico Zappone.  
 Assistant Chief of Division (in charge of Weather Bureau Accounts)—Edgar B. Calvert.  
 Cashier—M. E. Fagan.



## DIVISION OF PUBLICATIONS.

Editor and Chief—George William Hill.  
 Editor and Assistant Chief—Joseph A. Arnold.  
 Associate Editor—B. D. Stallings.  
 Assistant in Charge of Document Section—Robert B. Handy.  
 Assistant in Charge of Indexing—Charles H. Greathouse.  
 Assistant in Charge of Illustrations—Louis S. Williams.  
 Chief Clerk—A. I. Mudd.

## LIBRARY.

Librarian—Josephine A. Clark.  
 Assistant Librarian—Claribel R. Barnett.

## OFFICE OF PUBLIC ROADS.

Director—Logan W. Page.  
 Assistant Director—A. S. Cushman.  
 Chief Engineer—V. M. Peirce.  
 Chief of Records—M. O. Eldridge.  
 Testing Engineer—P. L. Wormeley, jr.  
 Chief Clerk—J. E. Pennybacker, jr.

## GROWTH OF THE DEPARTMENT.

On September 30, 1861, the Agricultural Division of the Department of the Interior, being the immediate predecessor of the United States Department of Agriculture, consisted of nine persons.

The Department of Agriculture was established July 1, 1862, according to the provisions of an act to establish the Department of Agriculture, approved May 15, 1862 (vol. 12, chap. 72, pp. 387, 388, U. S. Stat. L.).

*Growth of the force of the Department from September 30, 1863, to July 1, 1906.*

Date.	Number employed.	Date.	Number employed.
1863, September 30 .....	29	1891, July 1 a .....	1,577
1867, September 30 .....	99	1893, July 1 .....	1,870
1871, September 30 .....	84	1895, July 1 .....	2,043
1873, September 30 .....	92	1897, July 1 .....	2,444
1875, September 30 .....	90	1899, July 1 .....	2,965
1877, September 30 .....	77	1900, November 16 .....	3,128
1879, June 30 .....	93	1901, July 1 .....	3,388
1881, July 1 .....	108	1902, July 1 .....	3,789
1883, July 1 .....	239	1903, July 1 .....	4,200
1885, July 1 .....	214	1904, July 1 .....	4,504
1887, July 1 .....	328	1905, July 1 .....	5,446
1889, July 1 .....	488	1906, July 1 .....	6,242

a The large increase on July 1, 1891, resulted from the transfer of the Weather Bureau to the Department of Agriculture on that date.

## APPENDIX.

GENERAL ORDER NO. 99.

UNITED STATES DEPARTMENT OF AGRICULTURE,  
 OFFICE OF THE SECRETARY,  
 Washington, D. C., July 27, 1906.

It is hereby ordered that the APPOINTMENT OR EMPLOYMENT of any and every person who has been appointed in the United States Department of Agriculture to any position or employed in any capacity therein and given leave of absence without pay, or furloughed without pay commencing on any date prior to August 1, 1905, and whose said leave of absence or furlough without pay has continued in force and effect until the termination of July 31, 1906, is HEREBY TERMINATED, and the name of each such appointee or employee is hereby removed from the rolls of the Department. This order shall take effect on August 1, 1906.

JAMES WILSON, *Secretary.*

GENERAL ORDER No. 100.

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., July 27, 1906.*

In the United States Department of Agriculture no leave of absence without pay will hereafter be granted for a longer period than three months, except in special and peculiar cases, and no furlough without pay or leave of absence without pay shall continue in force and effect for a longer period than one year from the date of the commencement thereof.

JAMES WILSON, *Secretary.*

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DEPARTMENT CIRCULAR No. 4.

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., September 25, 1905.*

*To the officers and employees of the Department of Agriculture:*

The following regulations are promulgated for your guidance:

*Regulation I.*—No officer or employee of the Government who is in a position either to influence the award of a contract with the Department or to cause purchases of supplies to be made for the Department shall be interested in any firm, company, or corporation doing business with the Department.

*Regulation II.*—Officers or employees who are engaged upon investigations of special industries for the Department shall not be connected with or interested in any firm, company, or corporation whose scope of business includes the industry which the officer or employee is investigating for the Department; and an officer or employee engaged upon the above-described work shall in no case allow his name, his work, or his connection with the Department to be used in promoting or exploiting or selling stock in any firm, company, or corporation, the scope of whose business includes the special industry which such officer or employee is investigating for the Department.

*Regulation III.*—No officer or employee shall perform or be engaged upon work for private individuals, firms, companies, corporations, or institutions without the written consent of the Secretary, first had and obtained through the chief of the bureau, office, or division in which said officer or employee serves.

The purpose of this regulation is not to prevent officers and employees of the Department from performing proper work, outside of office hours, which does not interfere with or hamper work for the Department, but is designed to afford the Secretary an opportunity to pass upon the kind and quantity of outside work which may be permitted in order that such work shall not impair the usefulness of such officers or employees to the Government.

JAMES WILSON, *Secretary.*

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AMENDMENT TO DEPARTMENT CIRCULAR No. 4.

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., October 20, 1905.*

*To Chiefs of Bureaus, Offices, and Divisions:*

Regulation III of Department Circular No. 4 prescribes that—

No officer or employee shall perform or be engaged upon work for private firms, companies, corporations, or institutions without the written consent of the Secretary first had and obtained through the chief of the bureau, office, or division in which said officer or employee serves.

It is hereby ordered that before transmitting to the Secretary for his consideration the written application of an employee or officer for permission to engage in or continue any nonofficial occupation, the chief of the bureau, division, or office shall indorse upon said application his recommendation in the premises, whether of approval or disapproval.

JAMES WILSON, *Secretary.*

GENERAL ORDER NO. 87.

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., October 2, 1905.

*To Chiefs of Bureaus, Offices, and Divisions:*

A Committee on Personnel for the Department is hereby created. The committee will be composed of WILLET M. HAYS, Assistant Secretary of Agriculture; S. R. BURCH, Chief Clerk of the Department, and GEORGE P. McCABE, Solicitor of the Department.

Each chief of bureau, office, or division is hereby directed to report to the Secretary, for reference to the Committee on Personnel, dereliction of duty and actions prejudicial to the interests of the Department by employees thereof. This report shall be made as soon as the improper act is discovered by or is reported to the chief, and shall be followed by a prompt and full report of the action which has been taken or which is recommended by the chief. The committee shall consider all such cases and shall, when deemed necessary by them, investigate the cases further and make report thereon to the Secretary.

Any employee should report to his chief or to the Secretary any matter which, in the opinion of such employee, should be investigated by the committee. The committee is empowered to summon any employee as a witness.

It is not intended that the Committee on Personnel shall interfere with the maintenance of discipline, or a proper supervision of employees by chiefs of bureaus, offices, or divisions.

All communications to the committee should be addressed "Committee on Personnel, U. S. Department of Agriculture, Washington, D. C."

JAMES WILSON, *Secretary.*

ORDERS BY THE PRESIDENT.

EXECUTIVE ORDER.

No officer or employee of the Government shall, directly or indirectly, instruct or be concerned in any manner in the instruction of any person or classes of persons with a view to their special preparation for the examinations of the United States Civil Service Commission.

The fact that any officer or employee is found so engaged shall be considered sufficient cause for his removal from the service.

THEODORE ROOSEVELT.

THE WHITE HOUSE, *October 31, 1905.*

EXECUTIVE ORDER.

Civil Service Rule XII is hereby amended to read as follows:

RULE XII.—*Removal.*

1. In making removals or reductions, and in other punishment, penalties like in character shall be imposed for like offenses.

2. No person shall be removed from a competitive position except for such cause as will promote the efficiency of the service. When the President or head of an Executive Department is satisfied that an officer or employee in the classified service is inefficient or incapable, and that the public service will be materially improved by his removal such removal may be made without notice to such officer or employee, but the cause of removal shall be stated in writing and filed. When misconduct is committed in the view and presence of the President or head of an Executive Department, removal may be made summarily, and no statement of reasons need be filed.



3. Where a recommendation for removal or reduction in grade or compensation of an officer or employee is made to the head of an Executive Department by a bureau chief or other subordinate officer, the said head of Department may, in his discretion, require that the person sought to be removed be furnished with a statement in writing of the reasons for such action, and be allowed a reasonable time for personally answering the same.

4. The Civil Service Commission shall have no jurisdiction to investigate any removal unless it is alleged that the procedure required by section 2 of Rule XII has not been followed, or that the removal was made for political or religious reasons.

THEODORE ROOSEVELT.

THE WHITE HOUSE, November 17, 1905.

#### EXTENSIONS OF THE CLASSIFIED CIVIL SERVICE IN THE UNITED STATES DEPARTMENT OF AGRICULTURE UNDER ORDERS ISSUED BY SUCCESSIVE PRESIDENTS.

A large number of employees in Washington, D. C., numbering 116 persons, were, on June 30, 1888, classified.

The positions of observers, local forecast officials, and assistants in the Weather Bureau, outside of Washington, D. C., were classified on January 5, 1893, carrying 314 persons into the classified service.

The position of appointment clerk was classified on March 20, 1894.

The positions of inspectors and assistant inspectors, outside of Washington, D. C., in the Bureau of Animal Industry, were classified on July 1, 1894, carrying 67 persons into the classified service.

The positions of professors of meteorology in the Weather Bureau, Washington, D. C., were classified June 6, 1894, carrying 3 persons into the classified service.

The positions of chiefs and assistant chiefs of entomology and of ornithology were classified on July 12, 1894, carrying 4 persons into the classified service.

The positions of chief and assistant chief of pomology were classified on November 6, 1894, carrying 2 persons into the classified service.

The positions of messengers, assistant messengers, watchmen, plant mounters, and folders were classified on November 2, 1894, carrying 117 persons into the classified service.

The positions of chiefs and assistant chiefs of divisions, experts, artists, State statistical agents in the various bureaus and offices of the Department, and the positions of microscopists, assistant microscopists, taggers, stock examiners, clerks, and agents in the Bureau of Animal Industry were classified on July 1, 1895, carrying 754 persons into the classified service.

The position of messenger in the Weather Bureau, outside of Washington, D. C., was classified July 1, 1895.

The position of fireman was classified on July 15, 1895, carrying 12 persons into the classified service.

The positions of clerical laborers, messenger-laborers, carpenters, gardeners, mechanics, painters, etc., were classified on September 18, 1896, carrying 91 persons into the classified service.

Two hundred and sixty laborers employed in the Department in Washington, D. C., were carried into the classified civil service in March, April, and May, 1905, under the order of the President dated January 12, 1905.

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1906, whose appointment precedes July 2, 1900.*

[In the "Remarks" column "out" means out of the service of the Department.]

Name.	Date appointed.	Remarks.
Abel, Joseph .....	Dec. 1, 1894	Out from June 30, 1893, to Apr. 1, 1898.
Abel, Louis .....	Sept. 22, 1896	
Adair, Harry B. ....	.....do .....	
Adams, Charles .....	Sept. 27, 1893	
Adams, Jacob .....	May 11, 1889	
Adams, Norman R. ....	Nov. 30, 1892	
Adams, Sallie G. ....	Oct. 16, 1893	
Ainsworth, Frederick W. ....	Jan. 29, 1898	
Akin, Llewellyn C. ....	Jan. 24, 1898	
Alexander, John O. W. ....	Mar. 23, 1899	
Alexander, Sarah C. ....	Dec. 30, 1885	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Alexander, William.....	July 1, 1877	Out from Sept. 30, 1878, to July 1, 1882; out from June 30, 1893, to July 1, 1898.
Allen, Edward T.....	June 20, 1899	
Allen, Edwin W.....	Aug. 11, 1890	
Allen, Fannie M.....	Jan. 30, 1900	
Allen, Leslie J.....	Aug. 1, 1896	
Allyn, Amelia M.....	May 5, 1898	
Alton, D. R.....	May 8, 1889	
Alvord, Henry E.....	Nov. 27, 1885	Out from Mar. 31, 1889, to May 11, 1895.
Alwood, William B.....	May 22, 1885	Out from Dec. 31, 1888, to Sept. 15, 1900.
Anderson, Melancthon O.....	Feb. 24, 1898	
Anderson, Robert L.....	Mar. 2, 1893	
Anderson, Thomas J.....	Sept. 25, 1899	
Angelo, Frank M.....	Dec. 13, 1894	
Angelo, Oliver P.....	Dec. 16, 1893	
Anthony, Maria.....	Aug. 6, 1888	
Armsby, Henry P.....	June 16, 1898	
Armstrong, Anna B.....	Jan. 10, 1898	
Armstrong, Maud.....	Apr. 1, 1898	
Armstrong, Thomas L.....	June 25, 1889	
Arnold, Joseph A.....	July 8, 1891	
Atchison, John L.....	June 16, 1900	
Atherton, Ira K.....	Feb. 5, 1895	
Atherton, Onesimus G.....	Oct. 24, 1896	
Atwell, Howard J.....	Feb. 23, 1898	
Atwood, Mary A.....	Oct. 22, 1892	Out from June 15, 1893, to Feb. 7, 1898.
Austin, James.....	June 30, 1891	
Ayer, Don C.....	Aug. 9, 1893	
Babcock, Henry C.....	June 26, 1900	
Bablick, May E.....	Oct. 1, 1897	
Bagnall, John I.....	Sept. 6, 1899	
Bailey, Alfred L.....	Jan. 12, 1900	
Bailey, Vernon.....	May 4, 1887	
Baker, George S.....	May 28, 1891	
Baker, Lewis R.....	June 16, 1891	
Baldwin, Boyd.....	June 15, 1897	
Bale, Anna E.....	Jan. 29, 1898	
Ball, Carleton R.....	July 5, 1898	
Ball, Harry M.....	Oct. 25, 1898	
Ball, Isaac L.....	July 2, 1888	
Ballard, Nannie P.....	Jan. 26, 1897	
Baltimore, Catherine.....	May 6, 1895	
Balzer, Emil.....	May 20, 1891	
Bane, Philena M.....	July 24, 1896	
Banks, Nathan.....	July 1, 1890	Out from July 30, 1892, to Dec. 26, 1896.
Bannister, Ida.....	Aug. 15, 1893	
Barber, Fannie C.....	July 17, 1897	
Barnes, Almont.....	Oct. 1, 1868	Out from July 1, 1871, to Aug. 1, 1890; out from Nov. 15, 1893, to Apr. 3, 1896.
Barnett, Claribel R.....	May 18, 1895	
Barnum, Mary E.....	June 28, 1900	
Barnett, Arthur.....	June 30, 1899	
Barrow, Katie.....	Oct. 22, 1892	
Barry, Mary K.....	Apr. 24, 1895	
Barth, William C.....	Sept. 9, 1893	
Barthels, Amelia.....	June 17, 1892	
Barthold, Edward W.....	Nov. 3, 1898	
Bartholow, Francis A.....	Dec. 9, 1886	
Batchelder, Howard N.....	Dec. 23, 1898	
Bauman, George W.....	Aug. 11, 1893	
Baumel, Henry.....	Oct. 6, 1893	
Beal, Foster E. L.....	Dec. 6, 1886	
Beal, Walter H.....	Feb. 27, 1891	
Bean, Clarence.....	Apr. 11, 1896	
Beattie, Joseph G.....	Nov. 16, 1898	Out from Sept. 30, 1904, to Apr. 1, 1905; out from Mar. 13, 1906, to July 5, 1906.
Beattie, William R.....	Sept. 6, 1899	
Beckwith, Benny E.....	Jan. 18, 1899	
Beechy, Levi P.....	July 8, 1898	
Behnke, Albert E.....	Sept. 28, 1895	
Bell, Edmund W.....	Nov. 1, 1893	
Bell, Grace.....	Jan. 25, 1897	
Bell, Izetta A.....	Dec. 8, 1898	
Benedict, Francis G.....	Dec. 31, 1895	
Benedict, Raymond E.....	June 15, 1900	
Benneson, Addie E.....	Apr. 16, 1894	
Bennett, Joseph B.....	Mar. 10, 1891	
Bennett, Samuel E.....	Jan. 11, 1896	
Bennett, William.....	Apr. 12, 1893	
Benton, Frank.....	June 12, 1891	
Benton, Walter D.....	Apr. 7, 1898	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Berry, Winfield E. ....	July 1, 1894	Out from Dec. 1, 1895, to Mar. 11, 1899.
Berryhill, Miriam B. ....	July 16, 1898	
Bertram, Eli L. ....	Feb. 14, 1899	
Bessey, Charles E. ....	Sept. 18, 1899	
Bessey, Ernst A. ....	Feb. 11, 1898	
Best, George. ....	Dec. 13, 1893	
Bevelot, Clement. ....	Nov. 24, 1893	
Bibb, Adelbert G. ....	Sept. 28, 1895	
Bibb, Arthur H. ....	Apr. 17, 1896	
Bigelow, Willard D. ....	July 1, 1892	
Bird, William N. D. ....	Mar. 12, 1895	
Bitner, William A. ....	Aug. —, 1892	Out from Aug. —, 1893, to Feb. 15, 1898.
Bixby, Malvina A. ....	June 16, 1891	
Blackmar, Charles E. ....	June 4, 1892	Out from Dec. 14, 1893, to Aug. 1, 1897.
Blackwell, John E. ....	July 10, 1893	
Blair, John T. ....	Aug. —, 1892	Out from Mar. 31, 1893, to Jan. 3, 1898.
Blanche, Richard J. ....	Feb. 11, 1898	
Blankman, Rosie B. ....	May 31, 1884	
Blodgett, James H. ....	Mar. 10, 1900	
Blondell, Joseph E. ....	Apr. 12, 1893	
Boardman, James M. ....	July 14, 1898	
Bollinger, Howard L. ....	May 12, 1900	
Bond, George A. ....	Feb. 11, 1898	
Bonds, Estella C. ....	Apr. 1, 1898	
Bone, Clark C. ....	Dec. 31, 1890	Out from July 6, 1893, to Oct. 13, 1897.
Bonsteel, Jay A. ....	Nov. 29, 1898	
Borden, John J. ....	Feb. 21, 1896	
Boss, Martha. ....	June 25, 1897	
Boughner, George H. ....	Apr. 6, 1895	
Bowie, Mary S. ....	Feb. 15, 1887	
Bowman, Grace L. ....	Feb. 2, 1899	
Boyce, Nelson V. ....	May 25, 1900	
Bracey, Clarence E. ....	Jan. 29, 1892	
Brackett, Gustavus B. ....	Sept. 15, 1890	Out from Dec. 31, 1891, to Aug. 1, 1892; out from May 31, 1893, to Aug. 1, 1896. Out from Feb. 25, 1892, to Apr. 2, 1900.
Bradford, Virginia P. ....	Oct. 1, 1885	
Brady, Kate H. ....	Nov. 28, 1892	
Bragdon, Clara K. ....	Dec. 8, 1885	
Braginton, Frederick. ....	May 8, 1893	
Brandt, Martha E. ....	Dec. 1, 1896	
Bray, Thomas A. ....	Nov. 15, 1893	
Bray, William L. ....	Mar. 27, 1899	
Breedin, Louise. ....	Oct. 4, 1881	
Brent, Nannie W. ....	Nov. 22, 1892	
Brett, George W. ....	Apr. 6, 1895	
Brez, Coleman. ....	Aug. 12, 1897	
Briggs, Lyman J. ....	May 28, 1896	
Brister, Henry. ....	July 25, 1889	
Brittan, Martha A. ....	May 9, 1898	
Broadhurst, Robert A. ....	Dec. 24, 1895	
Broadus, Charity. ....	Aug. 2, 1897	
Brooks, Alex. H. ....	Nov. 15, 1889	
Brougham, James J. ....	July 23, 1891	
Brown, Charles A. ....	May 27, 1895	
Brown, Edgar. ....	June 30, 1899	
Brown, Henry E. ....	Aug. 21, 1899	
Browning, George W. ....	Mar. 29, 1900	
Bruce, Eugene S. ....	June 29, 1900	
Bruette, William A. ....	Apr. 28, 1892	
Bruser, Joseph. ....	Dec. 4, 1890	
Bruton, A. R. ....	Feb. 7, 1895	
Bryant, Reuben A. ....	Sept. 13, 1899	
Bryant, Ursula P. ....	Feb. 9, 1898	
Buckley John S. ....	Feb. 12, 1898	
Buckley, Margaret. ....	Dec. 11, 1899	
Bugbee, Clinton H. ....	June 8, 1900	
Bullard, L. L. ....	Nov. 19, 1890	
Bunce, Mary. ....	Aug. 15, 1893	
Bundy, Edward A. ....	July 11, 1898	
Burch, Sylvester R. ....	Sept. 5, 1891	
Burdick, Horace D. ....	Jan. 3, 1894	
Burgess, John L. ....	Apr. 20, 1900	
Burgess, William. ....	Apr. 17, 1896	
Burke, Edmund. ....	Apr. 15, 1869	
Burke, George C. ....	Oct. 28, 1893	
Burke, Laura. ....	June 16, 1891	
Burke, Margaret. ....	Jan. 29, 1898	
Burke, Mary L. ....	Aug. 15, 1893	
Burke, Richard T. A. ....	Nov. 18, 1899	
Burkhard, Jacob. ....	May 3, 1893	
Burleigh, Frank. ....	Sept. 26, 1891	



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Burlingame, Sarah A .....	June 1, 1882	Out from Jan. 15, 1884, to June 1, 1897.
Burnett, Daniel C .....	June 8, 1900	
Burr, M. Helen .....	Jan. 3, 1882	
Burt, Solomon W .....	June 4, 1892	
Burton, John W .....	Dec. 17, 1898	
Busck, August .....	Mar. 14, 1896	
Busman, Herman .....	Feb. 11, 1898	
Busteed, Henry W .....	Jan. 30, 1896	
Butler, George W .....	June 9, 1899	
Butterfass, Jacob F .....	Feb. 21, 1896	
Byrd, Martin L .....	Apr. 16, 1900	Out from June 13, 1893, to May 22, 1897.
Byrd, Oliver W .....	July 7, 1896	
Caldwell, Ella M .....	Dec. 28, 1897	
Caldwell, Herbert .....	July 14, 1899	
Cameron, Frank K .....	May 26, 1898	
Campbell, Charles E .....	Nov. 16, 1898	
Campbell, Larkin S .....	Nov. 11, 1898	
Canatsey, William S .....	Dec. 30, 1889	
Canfield, Charles H .....	Mar. 24, 1898	
Carle, Edward C .....	Sept. 22, 1896	
Carleton, Mark A .....	Apr. 8, 1891	
Carlisle, May E .....	Aug. 26, 1893	
Carnachan, Thomas W .....	Feb. 5, 1898	
Carney, James W .....	Sept. 7, 1892	
Carpenter, Stella L .....	Oct. 22, 1897	
Carr, Joseph G .....	Feb. 7, 1895	
Carroll, Charles C .....	July 7, 1899	
Carroll, John H .....	Apr. 29, 1899	
Carter, George .....	Jan. 1, 1887	
Carter, George A .....	July 6, 1891	
Cary, Emerson J .....	May 25, 1900	
Casper, Adolph M .....	Jan. 8, 1894	
Caudell, Andrew N .....	Oct. 24, 1898	
Castleman, Stephen D .....	Aug. 28, 1899	
Caster, Thomas .....	Mar. 25, 1897	
Cathcart, Ellen W .....	Oct. 31, 1889	
Cathel, George T .....	Feb. 3, 1894	
Chace, Edward McKay .....	July 1, 1898	
Chamberlin, Charles J .....	Feb. 20, 1894	
Champney, Mary G .....	Sept. 14, 1881	
Chaney, Herbert B .....	Mar. 24, 1898	
Chapin, Albert C .....	Feb. 2, 1899	
Chapman, Charles S .....	Mar. 31, 1900	
Chapman, Herman H .....	Dec. 11, 1899	
Chase, Agnes .....	Oct. 1, 1898	
Chase, Florence A .....	Apr. 26, 1900	
Cherrington, Wm. P .....	Nov. 23, 1893	
Chick, Thomas .....	May 1, 1895	
Chickering, Mary E .....	Apr. 5, 1898	
Chittenden, Frank H .....	Apr. 23, 1891	
Chojnacki, Michael .....	Apr. 9, 1894	
Christie, Inez J .....	Apr. 5, 1898	
Clancy, Joseph B .....	Aug. 9, 1893	
Clark, Blanche B .....	May 15, 1900	
Clark, Charles C .....	Oct. 11, 1899	
Clark, Charles B .....	Nov. 9, 1887	
Clark, Emma L .....	Aug. 16, 1882	
Clark, George W .....	Feb. 18, 1898	
Clark, Josephine A .....	Sept. 4, 1891	
Clark, Mary B .....	June 15, 1897	
Clark, Thomas G .....	June 15, 1891	
Clark, Vinton A .....	Nov. 26, 1898	
Clark, William D .....	June 15, 1891	
Clarke, Anna F .....	Aug. 21, 1893	
Clarke, Lowell .....	Oct. 19, 1895	
Cleary, Francis J. P .....	Mar. 18, 1892	
Clement, George E .....	June 15, 1900	
Cleveland, Treadwell, jr .....	Feb. 4, 1899	
Clifton, Richard S .....	Nov. 19, 1890	
Clothier, George L .....	June 29, 1900	
Cogan, Helen M .....	Apr. 5, 1898	
Cohoon, Anson E .....	Apr. 8, 1900	
Colbath, Mary F .....	Apr. 18, 1889	
Coleman, George J .....	Dec. 1, 1898	
Coles, Richman .....	Apr. 24, 1900	
Colgan, Kate .....	Aug. 1, 1894	
Collier, William .....	Oct. 2, 1893	
Collins, Guy N .....	Sept. 26, 1898	
Colman, Marie A. S .....	May 2, 1885	
Condon, James .....	July 14, 1891	
Cone, Fannie .....	June 12, 1893	Out from Mar. 9, 1895, to Mar. 9, 1898.

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Connell, Lydia.....	Dec. 8, 1898	
Connell, Marie J.....	Aug. 22, 1898	
Connolly, Mary.....	June 7, 1898	
Connor, Ross L.....	June 30, 1898	
Conoyer, Charles M.....	May 27, 1895	
Conway, Nora.....	Oct. 4, 1892	
Cook, Orator F.....	Nov. 4, 1898	
Cooke, Richard H.....	Feb. 1, 1864	
Cooney, Florence C.....	Apr. 1, 1888	
Cooper, Dean G.....	Feb. 24, 1898	
Cooper, John D.....	Nov. 3, 1894	
Cooper, W. Ross.....	Jan. 16, 1897	
Coquille, Daniel W.....	June 29, 1887	
Corcoran, Mamie L.....	June 6, 1893	
Corley, Jacob J.....	June 3, 1898	
Corridon, Margaret B.....	May 1, 1897	
Cosford, Samuel E.....	Nov. 30, 1895	
Cotton, William E.....	Sept. 22, 1893	
Covert, James R.....	Mar. 24, 1897	
Coville, Frederick V.....	July 5, 1888	
Cowan, Tressy.....	May 9, 1898	
Cowie, Charles.....	Jan. 23, 1892	
Cownie, John.....	June 3, 1898	
Cox, Frances C.....	July 18, 1883	
Cox, John T.....	Jan. 20, 1898	
Coyle, Thomas.....	Jan. 15, 1888	
Cracoft, T. Byron.....	Apr. 7, 1898	
Crain, Anna C.....	Oct. 20, 1886	
Cramer, Charles F.....	Apr. 24, 1896	
Crandall, William W.....	Jan. 12, 1893	
Crawford, William S.....	Apr. 5, 1895	
Crippen, Everett C.....	Sept. 25, 1899	
Croghan, Charles J.....	Oct. 4, 1893	
Crompton, Harry.....	July 1, 1891	
Crossman, Edgar A.....	June 27, 1900	
Crowell, Lillie M.....	Jan. 25, 1894	
Crowley, Nellie B.....	Jan. 29, 1898	
Cumming, David.....	Mar. 26, 1891	
Cunningham, Bernard.....	Dec. 6, 1893	
Curtis, Chester J.....	June 5, 1894	
Dahler, August L.....	June 20, 1898	
Dallas, Marie L.....	Dec. 31, 1897	
Dammann, Frederick A.....	June 7, 1895	
Damon, Nellie E.....	Feb. 1, 1894	
Danaher, William E.....	Nov. 3, 1899	
Daniels, Maria A.....	Dec. 20, 1892	Out from Apr. 16, 1895, to July 24, 1897.
Darg, John J.....	Sept. 26, 1899	
Darling, Annie E.....	June 29, 1900	
Darling, Robert W.....	Dec. 4, 1897	
Daugherty, Alice M.....	Oct. 16, 1894	
Daugherty, Charles M.....	Sept. 10, 1894	
Davies, Charles H.....	Sept. 17, 1891	
Davis, Estelle G.....	Apr. 1, 1898	
Davison, Elwin T.....	Aug. 26, 1896	
Dawley, Frank E.....	June 3, 1898	
Dawson, John W.....	June 18, 1900	
Day, Charles M.....	Nov. 14, 1894	
Day, L. Enos.....	Apr. 9, 1897	
Deadman, John F.....	May 27, 1899	
Deakins, William F.....	Sept. 7, 1894	
Dean, Albert.....	Mar. 29, 1890	
Dell, Harry H.....	Jan. 16, 1900	
Dennis, William R.....	Oct. 29, 1896	
Dent, Mary T.....	Apr. 2, 1887	
Des Granges, Henry W.....	July 5, 1898	
Dewey, Edith W.....	Oct. 31, 1898	
Dewey, Lyster H.....	Aug. 27, 1890	
De Wolf, Frank L.....	Sept. 26, 1892	
Dickinson, Mattie H.....	Jan. 20, 1898	
Dietrich, Ephraim.....	Apr. 16, 1896	
Dietz, Delia.....	Oct. 6, 1898	
Diller, Bertha L.....	Aug. 29, 1893	
Dillingham, Willis I.....	June 8, 1900	
Disney, Richard H.....	Apr. 1, 1882	
Ditewig, George.....	Aug. 1, 1896	
Divine, John P.....	June 26, 1899	
Dodge, Allen.....	Aug. 1, 1881	Out from July 7, 1895, to July 1, 1896.
Dodson, Bessie M.....	Jan. 18, 1892	
Dole, Sarah I.....	Apr. 8, 1897	
Dorset, Marion.....	July 24, 1894	
Dorsett, Palemon H.....	Feb. 19, 1891	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Dorsey, Clarence W.....	Sept. 21, 1898	
Douglas, Louise.....	May 20, 1897	
Dowd, Edward P.....	Sept. 5, 1895	
Doyle, William J.....	Feb. 27, 1895	
Drennon, Lou E.....	May 24, 1900	
Dreyer, Lewis S.....	Oct. 6, 1898	
Driscoll, Elizabeth M.....	Apr. 5, 1898	
Du Bois, Carrie L.....	May 7, 1883	
Du Bois, Coert.....	Apr. 20, 1900	
Dudley, William R.....	Nov. 24, 1899	
Due, Immanuel.....	Feb. 25, 1896	
Dufficy, James J.....	Dec. 30, 1893	
Dugan, Mary A.....	Nov. 30, 1896	
Duke, Annie L.....	June 1, 1897	
Duncan, Washington C.....	June 22, 1895	
Durfee, Clarence O.....	June 16, 1900	
Eaid, Cora A.....	June 7, 1898	
Earle, Ella B.....	Mar. 15, 1895	
Eastman, Joseph O.....	June 29, 1897	
Ecton, Thomas G.....	Dec. 18, 1893	
Edwards, Ella.....	May 1, 1882	
Eells, Frank C.....	Feb. 12, 1898	
Egan, Mary A.....	Sept. 26, 1894	
Ehlers, Carrie.....	Feb. 10, 1898	
Eichstaedt, Jacob J.....	June 5, 1894	
Eldridge, Maurice O.....	May 4, 1894	
Elmer, Charles.....	Sept. 7, 1894	
Elmore, Albert L.....	May 6, 1897	
Ellenberger, William P.....	Aug. 9, 1898	
Ellsworth, Carrie I.....	Dec. 31, 1892	
Ellsworth, Emma H.....	Jan. 25, 1894	
Emery, Mary E.....	July 1, 1889	
Emery, James A.....	Nov. 7, 1891	
Eriksen, Anna.....	July 5, 1893	
Espita, Mamie.....	Dec. 11, 1897	
Enright, Margaret.....	Sept. 2, 1893	
Evans, Iltyd C. I.....	Apr. 14, 1894	
Evans, Sallie A.....	Aug. 15, 1893	
Evans, Walter H.....	Oct. 1, 1892	
Evanson, Matilda.....	Dec. 21, 1897	
Ewing, Frank A.....	Apr. 18, 1894	
Fagan, Mary E.....	Oct. 16, 1893	
Fagan, Matthias E.....	Apr. 26, 1893	Out from Apr. 30, 1896, to Aug. 13, 1902.
Failyer, George H.....	Apr. 28, 1896	Out from Oct. 31, 1896, to July 1, 1902.
Fansher, Ethellena M.....	May 25, 1898	
Fairchild, David G.....	July 25, 1889	
Fairfax, Lucie E.....	May 1, 1888	
Fairfax, Thaddeus.....	Dec. 3, 1885	
Farley, David S.....	Mar. 21, 1892	Out from July 15, 1893, to Apr. 6, 1899.
Farrell, Lillian E.....	July 1, 1893	
Farrington, Arthur M.....	Aug. 1, 1884	
Farwell, Abbie M.....	Feb. 9, 1895	
Faunce, Archibald L.....	Oct. 1, 1898	
Faust, Louise.....	Oct. 30, 1894	
Faville, George C.....	Apr. 21, 1887	
Fealy, Nellie E.....	Dec. 16, 1889	
Fegley, Nathan K.....	May 29, 1896	
Feighner, John E.....	Dec. 16, 1899	
Ferguson, George R.....	June 23, 1890	
Fess, Frank J.....	Dec. 20, 1899	
Fila, Frank.....	Sept. 16, 1893	
Finch, Pearl M.....	June 7, 1898	
Finckel, Charlotte B.....	June 1, 1882	
Fink, John W.....	June 27, 1900	
Fish, James G.....	Sept. 25, 1893	
Fisher, Albert K.....	July 1, 1885	
Fisher, Gertrude.....	June 1, 1897	
Fisher, Richard T.....	June 17, 1898	
Fitzgerald, John N.....	June 24, 1895	
Flanagan, Susanna.....	Aug. 27, 1898	
Flannery, James.....	Dec. 18, 1890	
Fleming, James.....	Dec. 24, 1895	
Fleming, William R.....	Feb. 24, 1900	
Fletcher, Christine P.....	Aug. 22, 1894	Out from Jan. 11, 1895, to Dec. 3, 1897.
Flora, Josiah D.....	Mar. 17, 1894	
Flynn, William F.....	July 5, 1893	
Foley, James.....	do.....	
Foley, John.....	July 14, 1898	
Foley, William.....	Mar. 6, 1890	
Forbes, Reuben.....	June 30, 1891	Out from May 31, 1893, to Aug. 1, 1897.
Ford, Albert W.....	Nov. 3, 1899	
Ford, James.....	Sept. 22, 1896	



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Forsch, Minnie.....	June 20, 1893	Out from Jan. 21, 1894, to Aug. 18, 1897.
Fortier, Samuel.....	Aug. 1, 1899	
Foss, Alice N.....	Apr. 5, 1898	
Fowler, Lorena C.....	Jan. 31, 1899	
Fowkes, Albert.....	Dec. 29, 1892	
Fox, Jacob.....	Oct. 30, 1893	
Fox, William.....	Jan. 15, 1894	
Fox, William F.....	June 29, 1900	
Fraille, Manuele.....	Dec. 2, 1896	
Franklin, George A.....	June 12, 1895	
Fravel, Frank R.....	Sept. 28, 1895	
Frazier, Charles T.....	Oct. 15, 1898	
Frechette, Midge.....	Aug. 21, 1893	
Freedman, Charles.....	June 23, 1899	
Freeman, Harry D.....	Oct. 30, 1893	
Frey, Nannie B.....	Jan. 5, 1899	
Frickey, Irving B.....	Apr. 3, 1894	
Fries, J. August.....	Oct. 1, 1898	
Frisch, David.....	July 5, 1893	
Frost, Edna M.....	Dec. 12, 1898	
Gage, Abbie F.....	Dec. 7, 1892	
Galloway, Beverly T.....	Aug. 24, 1887	
Galloway, Maud P.....	June 1, 1897	
Gantt, John E. M.....	Mar. 21, 1889	
Gardner, Helen.....	Jan. 1, 1885	
Gardner, Lucy A.....	July 26, 1897	
Gardner, Wesley J.....	June 16, 1900	
Gardner, Frank D.....	Oct. 3, 1895	
Gardner, James.....	July 5, 1893	
Garmes, Moses W.....	Apr. 7, 1898	
Garner, Sarah L.....	May 9, 1898	
Garlick, William B.....	June 3, 1891	
Garrity, John J.....	Aug. 22, 1893	
Gaskins, John H.....	Jan. 15, 1897	
Gates, Otis H.....	June 1, 1896	
Geddes, Tooie A.....	Feb. 4, 1893	
Gelletly, Celia.....	Sept. 19, 1890	
George, Harrison H.....	Feb. 11, 1898	
Gerard, Missouri.....	July 16, 1892	
Gerdes, Herman H.....	Nov. 25, 1892	
Gerrish, James L.....	June 15, 1891	
Gibbs, W. H.....	Mar. 22, 1893	
Gibson, Annie.....	Nov. 7, 1894	
Gibson, Lulu E.....	Dec. 20, 1892	
Gill, Edgar.....	Mar. 11, 1899	
Gill, Sue M.....	June 29, 1900	
Gillett, Stephen D.....	Dec. 17, 1898	
Gillies, Duncan R.....	May 25, 1900	Out from July 31, 1902 to Feb. 1 1903.
Gilmore, Elias.....	June 30, 1891	
Gilmore, Frank J.....	Jan. 25, 1896	
Gobble, Washington.....	Jan. 29, 1894	
Gochenour, William P.....	Mar. 26, 1896	
Goebel, Fred J.....	Sept. 4, 1981	
Goetz, Lena B.....	Oct. 3, 1893	
Goggin, Mary F.....	Aug. 4, 1897	
Gold, Charles L.....	Jan. 6, 1898	
Goldman, Edward A.....	Mar. 1, 1892	Out from Aug. 15, 1893, to Oct. 13, 1897.
Goodchild, Martha A.....	July 1, 1884	
Goodpasture, Carroll O.....	May 21, 1898	
Gordon, James H.....	July 25, 1898	
Gordon, John C.....	July 23, 1890	
Gordon, William.....	Apr. 14, 1897	
Gorman, Mary.....	Aug. 26, 1891	
Grable, Hiram.....	May 28, 1896	
Granger, Dighton.....	Nov. 18, 1890	
Grady, Martin P.....	June 8, 1894	Out from Mar. 31, 1893, to Jan. 18, 1900.
Graves, Henry S.....	July 14, 1898	
Gray, Helen E.....	Mar. 18, 1895	
Gray, Richard W.....	July 1, 1894	
Gray, Robert.....	June 19, 1895	
Greathouse, Charles H.....	Mar. 27, 1897	
Green, Louis K.....	Sept. 22, 1896	
Green, Theodore T.....	Aug. 27, 1891	
Gregory, Samuel B.....	Sept. 14, 1894	
Gregory, Fannie N.....	July 15, 1882	
Gregor, Jeannette J.....	June 21, 1899	
Griffin, Patrick H.....	July 5, 1893	
Griffin, Milton R.....	Oct. 31, 1900	
Griffith, Edward M.....	Apr. 29, 1897	
Griffiths, David.....	July 14, 1897	
Grinnell, Henry.....	May 18, 1899	
Groesbeck, Daniel D. H.....	May 16, 1900	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Grosse, Charlotte R.....	Oct. 8, 1898	
Grove, John S.....	Apr. 1, 1899	
Guthridge, Adele G.....	Aug. 1, 1892	
Haas, Clara B.....	June 7, 1897	
Haas, John P. M.....	May 5, 1897	
Hager, Peter.....	June 25, 1897	
Haggerty, John J.....	Feb. 21, 1896	
Haines, William S. D.....	Dec. 19, 1888	
Hall, George I.....	Feb. 23, 1892	
Hall, Violet A.....	Nov. 17, 1896	
Hall, William E.....	Nov. 20, 1899	
Hall, William L.....	Sept. 11, 1899	
Halley, James.....	July 1, 1862	
Halsey, Sarah W.....	Dec. 16, 1892	
Hanawalt, David C.....	Feb. 24, 1900	
Hancock, Henry J.....	Apr. 1, 1898	
Handy, Robert B.....	Mar. 17, 1894	
Handy, Robert B., jr.....	Sept. 7, 1899	
Hanley, Thomas F.....	June 17, 1895	
Hanrahan, Josie.....	May 28, 1892	Out from June 15, 1893, to Aug. 20, 1897.
Hanrahan, Mary A.....	Aug. 30, 1893	
Hansen, Thomas.....	May 8, 1893	
Hanton, George T.....	July 23, 1891	
Harder, Fred W.....	Mar. 31, 1900	
Harlow, George A.....	Sept. 15, 1894	
Harpst, William.....	Dec. 11, 1890	
Harrington, Lucius F.....	Sept. 5, 1893	
Harris, Albert E.....	Apr. 24, 1896	
Harrison, Carrie.....	Aug. 23, 1887	Out from Sept. 30, 1894, to Jan. 1, 1898.
Harrison, Charles T.....	Apr. 23, 1898	
Harrison, Louise F.....	Aug. 8, 1887	
Harrison, Robert H.....	Jan. 29, 1898	
Hart, John E.....	June 30, 1891	
Hartley, Charles P.....	Nov. 1, 1899	
Harvey, William O.....	June 14, 1897	
Hascall, Morris T.....	Nov. 16, 1898	
Haskett, Bert.....	Nov. 3, 1899	
Hassall, Albert.....	May 24, 1887	Out from Apr. 24, 1890, to Mar. 7, 1891.
Hatch, Jennie E.....	Nov. 16, 1892	Out from Apr. 22, 1893, to Sept. 7, 1897.
Haughton, Nellie F.....	July 9, 1891	
Hauser, Ernest.....	June 30, 1879	
Hawes, Austin F.....	June 15, 1900	
Hawkins, Alfred.....	Apr. 24, 1889	
Hawks, Emma B.....	May 18, 1895	
Hawley, Hiram W.....	Oct. 19, 1895	
Haws, William A.....	May 2, 1892	
Hayden, James A.....	Dec. 17, 1890	Out from Mar. 31, 1895, to Jan. 17, 1898.
Hayes, Daniel S.....	Nov. 27, 1899	
Haywood, John K.....	Jan. 13, 1897	
Healy, Bessie M.....	Oct. 1, 1898	
Healy, Frank A.....	Nov. 4, 1899	
Hedrick, Horace A.....	July 10, 1893	
Heidemann, Otto.....	June 1, 1883	Out from Jan. 30, 1894, to Aug. 3, 1898.
Heiges, Bertha.....	Nov. 10, 1894	
Heil, Tillie.....	Dec. 21, 1897	
Helvey, Orlando W.....	Nov. 16, 1898	
Henderson, Alice.....	Feb. 24, 1900	
Henderson, Herbert.....	Mar. 24, 1898	
Hendren, Samuel G.....	Feb. 24, 1898	
Hendrix, James H.....	Nov. 30, 1894	
Henkel, Alice.....	July 26, 1899	
Henry, Mary.....	Aug. 21, 1893	
Henry, William.....	Aug. 16, 1894	
Herrick, Emma C.....	Dec. 1, 1892	
Herrick, Hiram G.....	Mar. 15, 1898	
Herriman, James P.....	June 24, 1895	
Herron, Franklin P.....	June 22, 1895	
Hersey, Walter H.....	Oct. 13, 1899	
Hess, Orlando B.....	Mar. 12, 1895	
Hickey, William P.....	Aug. 9, 1893	
Hickman, Jessie.....	Dec. 17, 1897	
Hickman, Richard W.....	Mar. 31, 1888	
Hickox, George S.....	Nov. 6, 1897	
Hicks, Elva E.....	Dec. 13, 1898	
Hill, George William.....	Oct. 1, 1888	
Hill, Harry L.....	Mar. 10, 1891	Out from Feb. 17, 1893, to July 7, 1898.
Hill, William E.....	May 22, 1893	
Hiller, Christian.....	Dec. 13, 1893	
Hines, Paul A.....	July 31, 1897	
Hinkson, Ransom.....	Apr. 25, 1894	
Hirleman, Arden L.....	Mar. 3, 1896	
Hodge, William C., jr.....	June 19, 1899	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Hodges, Addison J.....	Feb. 1, 1892	Out from June 15, 1893, to July 1, 1897.
Hodges, David R.....	Aug. 17, 1896	
Hoerner, George J.....	Apr. 24, 1896	
Hogan, Margaret.....	June 9, 1893	
Holcombe, Allen A.....	Aug. 4, 1899	
Holland, Jeremiah.....	June 8, 1894	
Holland, Nellie.....	Nov. 3, 1894	
Holland, R. Bowie.....	June 4, 1897	
Hollenbeck, John B.....	June 16, 1900	
Hollidge, Alfred H.....	Mar. 17, 1900	
Hollidge, Edward M.....	July 7, 1898	
Holman, Maud D.....	Feb. 26, 1898	
Holmes, Clara E.....	Apr. 5, 1898	
Holmes, George K.....	Mar. 8, 1898	
Honan, William C.....	July 5, 1893	
Hope, James G.....	Feb. 24, 1898	
Hopkins, Caroline M.....	May 9, 1898	
Hopkins, Frederick W.....	Feb. 7, 1896	
Hopper, John B.....	Nov. 1, 1893	
Hosken, Selena.....	Sept. —, 1892	
Hosler, Carrie B.....	Apr. 5, 1898	
Hosmer, Ralph S.....	Apr. 11, 1896	
Hostetler, Altue.....	Sept. 21, 1898	
Hotchkiss, Mary E.....	Nov. 21, 1892	Out from June 15, 1893, to Mar. 1, 1895.
Houck, Ulysses G.....	Sept. 4, 1896	
Housmann, Anna M.....	Apr. 6, 1893	
Howard, De Lannes.....	Sept. 7, 1893	
Howard, Leland O.....	Nov. 15, 1878	
Howe, Elmer D.....	Jan. 6, 1898	
Howe, Sarah W.....	Jan. 15, 1898	
Howe, Walter E.....	Apr. 1, 1898	
Howell, Arthur H.....	May 6, 1895	
Howes, Benjamin.....	Jan. 24, 1898	
Hoyt, Albert H.....	Apr. 21, 1893	
Huddleson, Sarah M.....	Sept. 30, 1889	
Huelsén, Julius.....	Mar. 10, 1888	
Huestis, Stella.....	Dec. 17, 1897	
Hughes, James F.....	Jan. 25, 1896	
Hughes, Sallie.....	Apr. 18, 1895	
Hull, William S.....	Oct. 24, 1900	
Hume, Harry F.....	May 29, 1896	
Humphrey, William E.....	Sept. 24, 1880	
Hunt, Myrtle A.....	Dec. 21, 1897	
Hunter, Abbie W.....	Jan. 25, 1894	
Hunter, Bertha S.....	Feb. 21, 1898	
Hunter, Effie M.....	Nov. 17, 1896	
Hunter, Walter D.....	June 9, 1898	
Huntington, Frederick W.....	Dec. 18, 1891	
Hurdle, Ivy V.....	May 1, 1900	
Hurley, Dennis.....	Feb. 21, 1895	
Hurley, Mary.....	Nov. 20, 1893	
Hutchinson, Charles B.....	Feb. 24, 1900	
Hutchinson, Emri C.....	June 19, 1898	
Hutchinson, Ernest N.....	July 30, 1896	
Hynes, William R.....	May 25, 1900	
Ingram, Martha M.....	June 15, 1882	
Ingram, Sarah A.....	Apr. 1, 1898	
Irons, George T.....	Apr. 7, 1899	
Irwin, Albert N.....	June 29, 1900	
Irwin, James.....	Mar. 19, 1890	Out from July 5, 1893, to Apr. 15, 1897.
Irwin, William N.....	Apr. 1, 1891	
Ivers, Robert.....	Jan. 8, 1900	
Jackson, Roy E.....	June 8, 1900	
Jackson, Robert E. L.....	June 14, 1893	
Jacobs, Harry C.....	May 2, 1899	
Jacobs, Joseph Otis.....	June 14, 1898	
Jacobson, John.....	Feb. 2, 1895	
Jacobus, Herman.....	June 24, 1895	
Jamieson, Annie.....	Apr. 29, 1895	
Jaqua, George E.....	Apr. 29, 1899	
Jeffrey, James G.....	Jan. 24, 1898	
Jelen, Frank.....	May 3, 1893	
Jenkins, Sarah E.....	Nov. 15, 1881	
Jerome, Hiram.....	Oct. 4, 1889	
Johnson, George A.....	June 25, 1892	Out from Apr. 16, 1893, to Apr. 1, 1897.
Johnson, Hattie M.....	Jan. 29, 1898	
Johnson, Louise.....	Dec. 21, 1897	
Johnson, Maria.....	Aug. 23, 1887	
Johnson, Martin A.....	June 27, 1883	Out from July 3, 1885, to Sept. 27, 1886.
Johnson, Ray F.....	Sept. 26, 1894	
Johnson, Raymond.....	July 26, 1899	



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Johnson, William H. ....	Dec. 4, 1891	
Johnson, Victorine E. ....	Apr. 1, 1897	Out from Jan. 31, 1898, to Nov. 29, 1899.
Johnston, Carrie E. ....	Sept. 30, 1889	
Johnston, Clarence T. ....	Nov. 1, 1899	
Johnston, James. ....	Nov. 12, 1895	
Jolliff, Jesse O. ....	Jan. 10, 1899	
Jones, Edward B. ....	July 9, 1883	
Jones, George S. ....	Mar. 1, 1898	
Jones, James E. ....	June 16, 1893	
Jones, Jennie. ....	Nov. 6, 1891	
Jones, May. ....	July 24, 1891	
Jones, Oliver F. ....	Nov. 16, 1896	Out from Sept. 21, 1897, to June 15, 1901.
Jones, William W. ....	Nov. 5, 1891	Out from Nov. 23, 1893, to Mar. 27, 1897.
Jordon, Joseph F. ....	July 5, 1893	
Jorden, William D. ....	Apr. 20, 1891	
Joslin, Mae B. ....	Nov. 26, 1892	Out from Apr. 14, 1893, to Aug. 20, 1897.
Jost, August. ....	Aug. 4, 1892	Out from Nov. 30, 1893, to Aug. 16, 1897.
Justinger, Michael. ....	June 24, 1893	
Kaufman, Elmer E. ....	June 3, 1898	
Kaupp, Benjamin F. ....	Feb. 5, 1896	
Kay, John Boyd. ....	Apr. 27, 1900	
Keach, John E. ....	June 16, 1900	
Kean, Mary E. ....	Aug. 19, 1893	
Keane, Charles. ....	Nov. 22, 1897	
Keane, Joseph S. ....	July 8, 1898	
Kearney, Thomas H. ....	Oct. 13, 1894	
Keese, Samuel L. ....	Aug. 21, 1899	
Kelcher, Thomas A. ....	Jan. —, 1884	
Keller, Lizzie. ....	Aug. 17, 1897	
Kelley, Michael C. ....	Apr. 7, 1899	
Kelley, Sarah G. ....	Apr. 3, 1898	
Kelly, Frankie E. ....	Dec. 28, 1897	
Kelly, Herman J. ....	Aug. 15, 1893	
Kelly, James S. ....	Mar. 25, 1897	
Kelly, John F. ....	July 24, 1894	
Kendrick, Henry M. ....	Sept. 12, 1894	
Kenneally, James S. ....	May 16, 1898	
Kennon, Genevieve G. ....	Mar. 18, 1897	
Kent, William H. B. ....	Apr. 26, 1900	
Kerr, James K., jr. ....	Dec. 10, 1898	
Kerr, James K., sr. ....	July 1, 1862	
Kershner, Peter I. ....	Jan. 26, 1897	
Ketchum, Frank D. ....	Sept. 22, 1896	
Key, Mary Tayloe. ....	June 1, 1897	
Kidder, Julius. ....	Sept. 12, 1892	Out from July 15, 1893, to Oct. 9, 1897.
Kiernan, John A. ....	Oct. 24, 1896	
King, George E. ....	Jan. 1, 1875	
King, Harriet F. ....	Feb. 15, 1898	
King, Minnesota J. ....	Aug. 1, 1898	
King, William M. ....	June 30, 1885	Out from Nov. 30, 1893, to Apr. 21, 1897.
Kilte, Asa H. ....	Dec. 16, 1893	
Klein, Louis A. ....	Mar. 24, 1898	
Kling, Myron H. ....	July 11, 1898	
Klingel, Annie. ....	Mar. 2, 1898	
Knapp, Seaman A. ....	June 3, 1898	
Knapp, S. Arthur. ....	June 1, 1900	
Knee, Ira F. ....	July 11, 1898	
Knipple, Robert G. ....	June 2, 1896	
Knott, Laura R. ....	July 8, 1899	
Knox, Harrison H. ....	Nov. 21, 1891	Out from Oct. 31, 1893, to Nov. 1, 1897.
Knox, Isabel D. ....	May 9, 1898	
Koch, Elers. ....	June 14, 1899	
Kochanowski, Reinhard. ....	June 16, 1891	
Koontz, George W. ....	Feb. 14, 1894	
Kortz, Otho D. ....	June 22, 1895	
Kostal, Anton. ....	May 3, 1893	
Kotinsky, Jacob. ....	Sept. 20, 1899	
Krowl, Isaac N. ....	Dec. 24, 1900	
Lace, Isabella. ....	May —, 1892	
Laird, Emily A. ....	Sept. 10, 1898	
Laird, Ernest E. ....	Oct. 14, 1892	Out from Jan. 21, 1894, to Sept. 15, 1897.
Lamson-Scribner, Frank. ....	May 11, 1885	Out from Nov. 30, 1901, to Apr. 15, 1904.
Lancaster, Carrie M. ....	Mar. 13, 1897	
Landvoigt, Charles. ....	Mar. 11, 1895	
Lane, James H. ....	June 25, 1895	
Langworthy, Charles F. ....	Aug. 1, 1894	
Lanigan, Oscar J. ....	Dec. 14, 1893	
Lannon, Mary F. ....	Aug. 30, 1893	
Lantz, Matthias S. ....	June 12, 1900	
Lapham, Macy H. ....	Sept. 21, 1899	
Latham, Ella G. ....	Feb. 12, 1883	
Lathrop, Wm. T. ....	July 28, 1899	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Lauck, Edward C.....	Oct. 8, 1898	
Lawlor, Lizzie D.....	Sept. 11, 1894	
Lawrence, Anastasia.....	Aug. 25, 1891	
Lawson, Alice.....	Aug. 4, 1897	
Lawson, Huron W.....	Oct. 17, 1898	
Lawton, Russell G.....	Feb. 7, 1900	
Leahy, Mary E.....	Aug. 19, 1893	
Leddy, Thomas.....	May 25, 1893	
Lee, Williams D.....	Jan. 27, 1900	
Leismann, Jacob.....	May 8, 1893	
Leith, Charles A.....	Nov. 24, 1891	Out from Mar. 30, 1893, to June 26, 1897.
Leland, Henry.....	Jan. 24, 1898	
Libby, Thomas M.....	Sept. 28, 1895	
Lidle, Lizzie.....	July —, 1892	
Lincoln, Willis B.....	Apr. 1, 1898	
Linderman, Tessie.....	June 18, 1892	
Lint, Milton C.....	July 30, 1898	
Long, Albert.....	Nov. 16, 1898	
Long, Michael.....	July 14, 1893	
Long, William W.....	Aug. 31, 1893	
Lorenzen, John C.....	June 24, 1895	
Love, Amelia H.....	May 7, 1882	Out from Sept. 10, 1894, to Apr. 29, 1897.
Loveberry, Clarence.....	Jan. 29, 1898	
Lovejoy, James E.....	Feb. 24, 1900	
Lower, Cyrus B.....	June 26, 1897	
Lower, Elsie E.....	Feb. 10, 1900	
Lowry, Thomas J.....	Mar. 15, 1895	
Luce, E. B.....	June 15, 1891	
Luce, Kate R.....	Aug. 28, 1891	Out from Apr. 22, 1893, to Aug. 17, 1897.
Lucid, Mary.....	May 2, 1893	Out from Oct. 31, 1893, to Dec. 16, 1893.
Luepke, John F.....	May 18, 1895	
Lukens, Theodore P.....	May 25, 1900	
Lyman, Richard B.....	Apr. 17, 1894	
Lynch, Daniel.....	Aug. 9, 1893	
Lynch, Kate.....	May 28, 1892	Out from Nov. 14, 1893, to Jan. 10, 1898.
Lyons, Josephine A.....	Dec. 5, 1894	
Lyons, Evelyn.....	Sept. 1, 1882	
Mace, Amy T.....	Dec. 21, 1897	
Mack, Ella S.....	Sept. 8, 1899	
Mackut, Frank.....	Sept. 15, 1894	
Madden, Michael J.....	Sept. 27, 1893	
Mader, Abraham.....	Oct. 6, 1893	
Magee, Morton.....	Nov. 3, 1898	
Mahana, Richard M.....	May 25, 1893	
Mahon, Martha H.....	Sept. 2, 1885	
Maloy, Edward J.....	Dec. 11, 1894	
Mann, Angus C.....	Oct. 19, 1891	
Manny, Abraham.....	Dec. 29, 1891	Out from July 15, 1893, to July 27, 1897.
Market, George.....	Dec. 22, 1893	
Markwood, Wesley.....	Sept. 29, 1893	
Marlatt, Charles L.....	Dec. 1, 1888	
Marshall, Mary G.....	June 15, 1888	
Martana, Kate.....	Jan. 6, 1893	
Martin, Elmer L.....	Feb. 1, 1900	
Martins, Alfred F.....	Feb. 12, 1898	
Mastius, Alfred G.....	July 30, 1890	
Mason, Joseph A.....	Dec. 14, 1891	
Mast, William H.....	June 16, 1900	
Masten, Pearl.....	Dec. 10, 1892	
Matile, James H.....	Jan. 24, 1895	
Maston, Bessie J.....	Jan. 29, 1898	
May, David W.....	Nov. 1, 1899	Out from Dec. 14, 1901, to May 1, 1904.
Maynard, M. Myrtle.....	Apr. 16, 1898	
Mayne, H. D.....	May 8, 1893	
Maus, Daisy C.....	Sept. 12, 1891	
Mead, Elwood.....	Mar. 22, 1899	
Mead, Rolla N.....	Mar. 22, 1900	
Meadors, Willis H.....	May 25, 1900	
Meek, Bella.....	July 28, 1898	
Meekham, Hofer S.....	June 29, 1900	
Melvin, Alonzo D.....	Dec. 10, 1886	
Merriam, C. Hart.....	July 1, 1885	
Merrill, Jay.....	July 10, 1893	
Mertell, Margaret.....	Aug. 15, 1893	
Messemmer, George E.....	Sept. 5, 1893	
Metcalfe, Martha L.....	Nov. 25, 1898	
Metsger, Michael.....	Sept. 7, 1893	
Metsker, Louis.....	Aug. 21, 1899	
Miller, Arthur E.....	May 2, 1899	
Miller, Chester.....	June 14, 1898	
Miller, Flora F.....	Oct. 3, 1896	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Miller, Joshua .....	Nov. 30, 1895	
Miller, Louis C. ....	June 16, 1900	
Miller, Monroe B. ....	Jan. 19, 1899	
Miller, Solomon .....	Apr. 23, 1894	
Miller, Susan J. ....	Oct. 24, 1898	
Milner, Robert D. ....	Jan. 1, 1899	
Milton, Mary H. ....	Feb. 1, 1893	Out from May 20, 1893, to Feb. 10, 1898.
Mohler, John R. ....	Jan. 21, 1897	
Molloy, John J. ....	June 22, 1895	
Montgomery, Anna. ....	July 18, 1883	
Mooney, Charles N. ....	Dec. 3, 1898	
Moor, William H. ....	Aug. 15, 1891	
Moore, Charles C., jr. ....	Mar. 19, 1894	
Moore, Ella D. ....	Mar. 23, 1897	
Moore, Felix T. ....	Sept. 1, 1893	Out from Aug. 31, 1894, to Feb. 4, 1897.
Moran, Anna L. ....	July 29, 1892	
Morgan, Porter .....	May 3, 1894	
Morgan, Susie .....	June 16, 1897	
Morin, Cyprien L. ....	July 6, 1897	
Morley, Henry .....	Sept. 7, 1892	Out from Dec. 14, 1893, to Aug. 1, 1897.
Morrison, Ada B. ....	Oct. 1, 1886	
Morrison, Mary .....	Oct. —, 1892	
Morrison, Robert J. ....	Feb. 13, 1900	
Morse, Charles H. ....	June 3, 1898	
Morse, Charles H. ....	Nov. 6, 1893	
Morse, George B. ....	Aug. 4, 1899	
Morton, Emory C. ....	July 26, 1897	
Moseley, Maggie M. ....	Aug. 26, 1899	
Moser, George C. ....	Oct. 5, 1893	
Mott, Henry S. ....	Oct. 1, 1894	
Mowerer, William E. ....	Apr. 7, 1898	
Moxley, James A. ....	July 1, 1898	
Mudd, Aloysius I. ....	May 1, 1897	
Muldowney, Patrick H. ....	Jan. 10, 1898	
Munn, John E. ....	Nov. 23, 1895	
Munro, James .....	May 3, 1894	
Murphy, Bernard W., jr. ....	Nov. 4, 1899	
Murphy, James A. ....	June 15, 1891	
Murphy, Jessie A. ....	June 1, 1897	
Murphy, John .....	July 24, 1891	
Murphy, Katie A. ....	Aug. 6, 1892	
Murphy, Thomas C. ....	June 5, 1894	
Murphy, Wilbur J. ....	Nov. 19, 1895	
Murray, Frank E. ....	May 25, 1900	
Murray, Mamie F. ....	Aug. 19, 1893	
Murray, William A. ....	Mar. 17, 1893	
Myer, Alice .....	Apr. 3, 1900	
Myers, Harry B. ....	Sept. 19, 1899	
Myers, Murray J. ....	Mar. 24, 1898	
McBirney, John .....	Sept. 28, 1895	
McBride, Archibald .....	May 29, 1896	
McCane, Eliz L. ....	Jan. 29, 1898	
McCann, John .....	June 24, 1895	
McCarthy, Evelyn C. ....	Dec. 21, 1897	
McClure, Mary M. ....	Oct. 27, 1893	
McCurdy, Frank C. ....	Mar. 24, 1898	
McCutchen, Marguerite .....	July 1, 1884	
McDonald, Donald .....	Feb. 13, 1895	
McDonald, Harry L. ....	Apr. 20, 1894	
McDonell, Emily E. ....	Aug. 26, 1896	
McDonnell, Rosanna .....	Apr. 1, 1898	
McEnaney, Joseph P. ....	Dec. 20, 1890	
McFarland, Claude M. ....	June 6, 1900	
McGill, James L. ....	Jan. 10, 1898	
McGlasson, Lizzie G. ....	Apr. 30, 1892	
McKay, William .....	June 24, 1895	
McKay, William L. ....	May 11, 1896	
McLeland, Thomas A. ....	Oct. 14, 1892	Out from Mar. 31, 1894, to Aug. 1, 1897.
McNally, Henry R. ....	Nov. 8, 1898	
McShane, Mary .....	Feb. 7, 1895	
Nau, Katherine A. ....	Nov. 6, 1899	
Neil, Wesley N. ....	Oct. 7, 1899	
Neill, Elizabeth L. ....	Dec. 22, 1897	
Nelson, Edward W. ....	Oct. 27, 1890	
Nelson, Elias .....	June 23, 1900	
Nelson, Ella M. ....	Mar. 5, 1900	
Nelson, John F. ....	Feb. 7, 1896	
Nelson, William .....	July 23, 1890	Out from May 4, 1894, to Jan. 17, 1898.
Newlove, Harry S. ....	Dec. 22, 1896	
Newman, George R., jr. ....	Aug. 4, 1894	
Newmyer, Edwin J. ....	Feb. 14, 1900	



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Newton, Amanda A .....	Feb. 6, 1894	
Newton, Harrison L .....	Nov. 3, 1894	
Newton, Virginia B. ....	Jan. 23, 1900	
Nicholas, John .....	Sept. 18, 1894	
Nichols, Indiana J. ....	May 1, 1889	
Nichols, Sue .....	Oct. 15, 1897	
Nicolai, Annie .....	Sept. 12, 1891	
Niles, William B. ....	Aug. 12, 1898	
Noah, Ester .....	July 6, 1898	
Noak, Louisa .....	Feb. 23, 1898	
Northen, William J. ....	Nov. 7, 1894	
Norton, Jesse B. ....	Feb. 24, 1898	
Nowlan, Frank P. ....	Apr. 17, 1899	
Oberholser, Harry C. ....	Jan. 19, 1895	
Oberly, Beatrice C. ....	Dec. 7, 1899	
O'Brien, Terence .....	July 5, 1893	
O'Donoghue, Clara .....	Apr. 13, 1887	
Ogden, Bessie D. ....	Mar. 9, 1895	
Ogden, Elsie L. ....	June 26, 1895	
Ogden, Jessie G. ....	Aug. 1, 1894	
O'Keefe, Matthew .....	Feb. 21, 1896	
Olden, John W. ....	June 30, 1889	
O'Leary, John P. ....	Jan. 25, 1896	
Olmsted, Frederick E. ....	June 1, 1900	
Olsen, Louise C. ....	Sept. 17, 1891	Out from June 15, 1893, to Jan. 3, 1898.
O'Malley, John J. ....	June 24, 1895	
O'Rourke, Arthur J. ....	Oct. 29, 1896	
O'Rourke, Isaac W. ....	May 25, 1900	
Orton, Warren S., sr. ....	Sept. 30, 1893	
Orton, William A. ....	June 1, 1899	
Osborne, Nora .....	Dec. 29, 1892	
Osgood, Wilfred H. ....	Mar. 2, 1897	
Oshel, Thomas W. ....	July 11, 1890	
Otterman, James L. ....	Aug. 9, 1898	
Owen, Frank D. ....	Jan. 25, 1900	
Owens, Maude .....	May 25, 1900	
Page, John E. ....	Nov. 8, 1899	
Paine, Phelps .....	June 27, 1891	Out from May 3, 1893, to May 22, 1897.
Palmer, Charles F. ....	Oct. 7, 1899	
Palmer, Theodore S. ....	Apr. 1, 1889	
Parker, Annie .....	May 2, 1887	
Parker, Joseph W. ....	Apr. 20, 1897	
Parker, Sallie M. ....	June 15, 1888	
Passmore, Deborah G. ....	Aug. 1, 1892	
Patrick, George E. ....	Dec. 16, 1895	
Patterson, Flora W. ....	June 15, 1896	
Patton, Don W. ....	Sept. 22, 1896	
Patton, H. Maria .....	Jan. 5, 1899	
Pauley, Mamie .....	Mar. 2, 1898	
Paxson, Harry D. ....	Dec. 24, 1896	
Payne, Albert J. ....	May 25, 1895	Out from Mar. 15, 1903, to Jan. 18, 1904.
Payne, Charles E. ....	Sept. 1, 1898	
Payne, Jacob I. ....	Oct. 30, 1893	Out from May 31, 1893, to July 16, 1897.
Payton, John B. ....	July 7, 1892	
Pearson, Charles .....	June 9, 1898	
Peck, Gerald E. ....	Apr. 7, 1897	
Peirce, Mabel R. ....	Jan. 17, 1900	
Pendleton, Mary L. ....	May 5, 1898	
Pennybacker, Isaac S. ....	May 9, 1894	
Pepperman, Alfred N. ....	Jan. 21, 1896	
Pergande, Theodore .....	June 30, 1879	
Perkins, Virginia .....	July 10, 1891	
Perry, Frederic M. ....	Aug. 30, 1894	
Perry, George W. ....	June 3, 1898	
Perry, James M. ....	June 30, 1883	
Perry, Owen R. ....	May 29, 1900	
Peters, Edward T. ....	Oct. 13, 1883	
Petty, Frederick O. ....	Jan. 12, 1899	
Pew, Charles S. ....	Dec. 6, 1893	
Pew, Irving W. ....	Jan. 4, 1896	
Pfunder, William .....	June 9, 1900	
Phillips, William L. ....	June 30, 1885	
Phillips, Oscar A. ....	Dec. 21, 1898	
Philpot, Charles W. ....	July 23, 1891	Out from June 30, 1893, to Oct. 18, 1897.
Phipps, William H. ....	May 1, 1900	
Pickens, James M. ....	Jan. 6, 1897	Out from Dec. 31, 1899, to June 29, 1900.
Pidcock, Walter S. ....	July 5, 1893	
Pierce, Anna L. ....	Jan. 25, 1899	
Pierce, Newton B. ....	May 7, 1889	
Pieters, Adrian J. ....	Mar. 1, 1895	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Pilcher, Charles H.....	Jan. 27, 1894	
Pinchot, Gifford.....	June 21, 1898	
Pistor, Adolph J.....	Dec. 8, 1898	
Platt, Daniel S.....	Jan. 15, 1894	
Polton, Emma R.....	Mar. 23, 1897	
Poore, William.....	July 24, 1899	
Pope, George W.....	Nov. 1, 1895	
Posey, Kate.....	July 30, 1897	
Pote, Thomas B.....	Mar. 20, 1900	
Potter, Hervey T.....	May 4, 1899	
Powell, Barbara E.....	July 19, 1899	
Powers, Allen R.....	June 15, 1900	
Pratt, Frederic C.....	Mar. 10, 1893	
Pratt, Harrie A.....	Dec. 30, 1899	Out from Sept. 2, 1902, to June 3, 1904.
Preble, Edward A.....	Mar. 29, 1892	
Price, Almira.....	Feb. 27, 1892	Out from June 15, 1893, to Apr. 5, 1897.
Price, Harry N.....	Dec. 20, 1894	
Price, John O. F.....	July 26, 1899	
Price, Mary E.....	Jan. 14, 1892	Out from May 15, 1893, to Sept. 1, 1897.
Price, Overton W.....	May 11, 1899	
Proudfoot, William.....	June 23, 1891	
Puette, Grace.....	May 28, 1898	
Pugh, William T.....	Aug. 5, 1899	
Purcell, John, jr.....	Aug. 17, 1893	
Quinn, Anna M.....	Sept. 24, 1894	
Quinn, Eva H.....	Sept. 1, 1882	Out from Oct. 13, 1893, to May 19, 1897.
Quinn, Maggie.....	July 2, 1898	
Quinn, Matthew.....	Apr. 6, 1893	
Quinn, Patrick E.....	Nov. 1, 1895	
Quirk, Michael J.....	Nov. 22, 1890	
Rader, Frederick E.....	Feb. 27, 1900	
Ragan, William H.....	May 13, 1898	
Ramsay, Robert A.....	Feb. 1, 1899	
Rapp, Emma V.....	July 28, 1899	
Ray, Thomas J.....	Mar. 15, 1865	
Rae, Thomas B.....	May 18, 1900	
Reamy, Thomas B.....	Mar. 11, 1893	
Redmond, Thomas.....	Apr. 20, 1898	
Reed, Mary T.....	Apr. 1, 1883	
Reese, Robert M.....	Dec. 19, 1890	
Reeves, Sallie R.....	Dec. 13, 1899	
Reinhart, Mary.....	May 10, 1892	
Reinsch, George J.....	Apr. 30, 1895	
Reynolds, McPherson.....	Feb. 17, 1897	
Rice, Albert G.....	Jan. 7, 1897	
Richards, Alice H.....	Oct. 22, 1892	Out from Apr. 22, 1893, to Mar. 1, 1895.
Richards, Isaiah.....	Nov. 16, 1898	
Richards, John.....	Aug. 28, 1895	
Richards, William H.....	June 1, 1897	
Richardson, A. G. G.....	Nov. 26, 1894	
Richardson, John H.....	Apr. 28, 1894	
Ridgeway, Basil F.....	Oct. 19, 1891	
Ridley, Cora M.....	July 14, 1899	
Rieder, Agnes B.....	Dec. 17, 1897	
Rieman, Henry L.....	Apr. 9, 1894	
Riggles, Thomas.....	July 1, 1892	
Riley, Sarah A.....	Feb. 1, 1894	
Riley, Smith.....	May 1, 1899	
Rishel, Albert E.....	Feb. 24, 1898	
Risley, Samuel A.....	Sept. 21, 1898	
Ritchie, Mary E.....	Nov. 22, 1894	
Ritter, Bella.....	Nov. 24, 1894	
Rittue, Edward C.....	July 15, 1895	
Robertson, James T.....	Dec. 19, 1892	Out from May 15, 1893, to Nov. 1, 1897.
Robey, Hattie.....	Apr. 1, 1897	
Robinson, George H.....	Nov. 3, 1899	
Robinson, Lila.....	Jan. 25, 1894	
Robinson, Louis A.....	Aug. 30, 1893	
Robinson, Matthew.....	Feb. 17, 1892	Out from June 15, 1893, to May 1, 1897.
Robinson, Rachel E.....	Jan. 20, 1898	
Rockwell, Josephine.....	Dec. 21, 1897	
Rockwell, Mabel.....	Sept. 25, 1891	
Roe, Ida M. B.....	Feb. 25, 1898	
Rogers, Burton R.....	May 25, 1900	
Rogers, Jessie E.....	Jan. 29, 1898	
Rogers, Plum A.....	June 3, 1898	
Rollins, Lizzie.....	July 15, 1890	
Roosa, Isaac P.....	June 26, 1897	
Roome, Henry.....	Sept. 15, 1899	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Rosa, John J.....	Jan. 8, 1898	
Rose, W. H.....	July 16, 1884	
Rose, Lillian.....	Nov. 26, 1898	
Ross, Matilda.....	June 30, 1900	
Rothrock, Leulah.....	June 27, 1887	
Rowles, Maud E.....	Jan. 20, 1898	
Rowse, Charles W.....	Nov. 1, 1895	
Roy, Blanche.....	Nov. 24, 1894	
Rue, Ernest E.....	June 12, 1896	
Russell, Fremont L.....	Jan. 1, 1891	
Russell, George H.....	Nov. 4, 1897	
Rutledge, Blanche.....	Dec. 27, 1892	
Rutledge, Thomas.....	Dec. 19, 1881	Out from Mar. 15, 1894, to Mar. 30, 1897.
Rutter, Frank R.....	May 26, 1899	
Ryan, John J.....	July 5, 1893	
Ryan, Nellie A.....	Oct. 8, 1892	
Ryder, Herman R.....	July 1, 1899	
Ryder, James F.....	Apr. 17, 1888	
Ryder, Mary E.....	Jan. 26, 1900	
Ryon, Millard F.....	Sept. 21, 1893	
Safford, Mary F.....	Dec. 10, 1883	
Sage, Fannie.....	Dec. 5, 1892	Out from May 23, 1893, to Aug. 20, 1897.
Sappington, Morey A.....	Apr. 17, 1896	
Sarsfield, John W.....	July 5, 1893	
Sauer, Theodore.....	Aug. 7, 1891	
Saunders, Belle C.....	June 30, 1889	
Saunders, William H.....	Apr. 5, 1898	
Savage, Willard A.....	Mar. 24, 1898	
Sawtell, Joseph E.....	May 10, 1892	Out from Nov. 14, 1893, to Apr. 1, 1901.
Saylor, Charles F.....	May 10, 1897	
Scanlan, Hannah.....	Mar. 28, 1892	
Scanlon, Patrick.....	Apr. 1, 1868	
Schaake, Josephine A.....	Sept. 28, 1897	
Schafer, Cecil K.....	Apr. 5, 1898	
Schaffter, Edward P.....	July 7, 1896	
Schauer, Henry.....	Sept. 19, 1893	
Schauflier, Charles A.....	June 16, 1893	
Scheerer, George W.....	Sept. 11, 1894	
Scherbel, Ernest F.....	July 15, 1898	
Schibsby, Lawrence.....	Oct. 30, 1893	
Schierman, John F.....	July 5, 1893	
Schmidt, Flora.....	June 15, 1883	
Schmitt, Casper J.....	Apr. 24, 1886	
Schnell, Martha.....	June 7, 1898	
Scholz, Ida M.....	Apr. 16, 1898	
Schopp, Henry.....	Sept. 12, 1893	
Schroeder, Frank.....	May 28, 1891	
Schroeder, George H.....	Oct. 20, 1891	Out from May 31, 1893, to Aug. 1, 1898.
Schwahn, Ella.....	Dec. 28, 1897	
Schwarz, Eugene A.....	Nov. 15, 1878	
Schwarz, George Fred.....	Jan. 26, 1899	
Schufeldt, Jennie M.....	Nov. 24, 1894	
Schulte, John I.....	Mar. 30, 1897	
Schultz, Hattie.....	Sept. 11, 1891	
Schumacher, George E.....	Feb. 3, 1896	
Scotfield, Carl S.....	Mar. 31, 1900	
Scott, Thomas A.....	Mar. 1, 1898	
Scott, Thomas W.....	Apr. 5, 1900	
Scribner, Leroy.....	Dec. 1, 1896	
Searles, Mae.....	Dec. 12, 1898	
Seaton, Charles H.....	Feb. 28, 1891	
Seaton, Sarah F.....	June 20, 1883	Out from Oct. 15, 1893, to June 16, 1897.
Seeley, Cora L.....	Dec. 19, 1892	
Seidell, Atherton.....	Apr. 7, 1900	
Selby, Stephen A.....	Nov. 21, 1895	
Sergeant, Fred W.....	Nov. 27, 1896	
Shale, Harvey L.....	Nov. 22, 1898	
Shanahan, Mary E.....	Oct. 18, 1887	
Shannon, John D.....	Oct. 31, 1893	
Shannon, John W.....	Jan. 18, 1894	
Shatzell, Harry A.....	Jan. —, 1892	Out from May 31, 1893, to Aug. 4, 1897.
Shaw, Mae H.....	Dec. 1, 1896	
Shea, Thomas.....	July 12, 1893	
Shear, Cornelius L.....	May 28, 1895	
Sheehan, Mary.....	Dec. 1, 1896	
Sheehan, Nellie.....	Oct. 1, 1898	
Sheerer, George W.....	Sept. 11, 1894	
Sherman, Henry C.....	Apr. 22, 1898	
Sherrard, Thomas H.....	July 5, 1899	
Shimoneck, William C.....	Apr. 7, 1890	Out from Dec. 31, 1893, to Apr. 3, 1897.



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Shipley, Trajan A .....	Mar. 12, 1895	
Shortridge, Ireneus .....	Nov. 15, 1895	
Shumway, Daniel G .....	Apr. 4, 1899	
Siegmund, William C .....	Jan. 10, 1898	
Siggins, Ernest L .....	Apr. 17, 1893	
Sigler, Pearl C .....	Oct. 1, 1898	
Simpson, Frederick L .....	Sept. 7, 1893	
Simpson, James R .....	Oct. 1, 1898	
Sine, John B .....	Apr. 20, 1891	
Singleton, Frank E .....	June 29, 1900	
Singleton, Henry .....	May 16, 1898	
Skinner, Sara .....	June 30, 1893	
Skinner, William A .....	Nov. 12, 1895	
Slater, Margaret V .....	Apr. 18, 1894	
Slee, John G .....	Apr. 9, 1897	
Sloan, John A .....	June 8, 1899	
Small, Cyrus K .....	Jan. 4, 1896	
Smedes, Henrietta R .....	Feb. 13, 1893	
Smith, Clarence B .....	Apr. 3, 1896	
Smith, Edward M .....	July 11, 1898	
Smith, Erwin F .....	Sept. 20, 1886	
Smith, Herbert M .....	Aug. 14, 1897	
Smith, Ida G .....	Jan. 10, 1900	
Smith, Jared G .....	Mar. 12, 1895	
Smith, Lydia J .....	Mar. 5, 1885	
Smith, Mary J .....	Sept. 21, 1899	
Smith, Moses .....	Mar. 7, 1895	
Smith, Nathaniel B .....	June 8, 1900	
Smith, Philip .....	May 3, 1893	
Smith, Robert E .....	Oct. 1, 1866	
Smith, Samuel T .....	Jan. 9, 1894	
Smith, Thomas M .....	Aug. 12, 1892	
Smith, William G .....	June 30, 1899	
Smith, William H., jr .....	Mar. 24, 1898	
Snyder, Frank .....	Apr. 26, 1897	Out from Oct. 15, 1899, to Dec. 18, 1899.
Snyder, Jared M .....	Mar. 15, 1897	
Snyder, Orrin W .....	June 13, 1891	Out from May 15, 1894, to Oct. 1, 1896.
Somers, John P .....	Oct. 30, 1894	
Somers, Mary .....	Feb. 7, 1895	
Sommers, Joseph M .....	Sept. 22, 1896	
Sommers Sarah L .....	Dec. 12, 1879	
Sorensen, Biels C .....	July 1, 1895	
Sowers, Sylvester S .....	Nov. 12, 1898	
Spaford, Goldie B .....	May 9, 1898	
Spalding, Katherine O .....	Jan. 14, 1899	
Sparhawk, William T .....	Feb. 13, 1900	
Speake, Edward O .....	Mar. 21, 1898	
Spencer, Guilford L .....	July 12, 1883	Out from Sept. 24, 1894, to Feb. 13, 1895.
Spencer, Lizzie .....	July 20, 1892	Out from May 10, 1893, to Aug. 20, 1897.
Speller, Turner R .....	Sept. 20, 1897	
Spethmann, Marie T .....	Mar. 25, 1899	
Sprague, Frank .....	Mar. 19, 1895	
Stafford, James R .....	Nov. 21, 1891	Out from Sept. 10, 1892, to Feb. 7, 1898.
Stallings, Benjamin D .....	Oct. 3, 1896	
Stamper, William S .....	Sept. 6, 1893	
Stannard, Jay D .....	May 11, 1900	
Steddom, Rice P .....	Mar. 25, 1897	
Stedman, Royal G .....	May 29, 1900	
Stedman, William P .....	Sept. 5, 1893	
Stell, James M .....	June 29, 1892	Out from Sept. 30, 1893, to Aug. 1, 1897.
Steiniger, Thora .....	Feb. 1, 1888	
Stephens, Edwin E .....	Dec. 1, 1896	
Sterrett, William D .....	June 15, 1900	
Steuart, Janette .....	Jan. 4, 1895	
Stevens, Frederick L .....	July 1, 1899	
Stevens, Margaret E .....	May 11, 1898	
Stevenson, Joseph H .....	June 8, 1899	
Stewart, Daisy .....	Jan. 20, 1898	
Stewart, John W .....	July 1, 1898	
Stewart, Walter J .....	June 9, 1896	
Stier, David W .....	May 24, 1894	
Stine, Benjamin L .....	Mar. 26, 1892	Out from Apr. 30, 1893, to Aug. 1, 1897.
Stingley, Orville A .....	Jan. 11, 1899	
Stoddart, Mary C .....	Sept. 1, 1884	
Stone, Israel W .....	June 5, 1889	Out from Aug. 31, 1893, to Mar. 20, 1896.
Stoner, Walter E .....	Apr. 2, 1897	
Stout, Oscar V. P .....	Jan. 17, 1900	
Stover, Arthur P .....	Aug. 9, 1899	
Strange, Anna R .....	Jan. 22, 1898	
Strong, Blanche .....	June —, 1900	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Strong, Jacob .....	May 1, 1895	
Stuart, James T. ....	May 13, 1893	
Stuck, Emil H. ....	Nov. 23, 1893	Out from May 24, 1898, to Apr. 1, 1899.
Stumpf, Louis N. ....	June 6, 1893	
Sudworth, George B. ....	Aug. 31, 1886	Out from July 22, 1898, to Mar. 15, 1899.
Sullivan, Etta Mary .....	Jan. 30, 1900	
Sullivan, Mary .....	Nov. 1, 1884	
Sullivan, Joseph .....	Feb. 7, 1895	
Sullivan, William J. ....	Aug. 9, 1893	
Summers, John .....	May 8, 1893	
Sutherland, George .....	June 21, 1894	
Sutherland, W. O. ....	Dec. 29, 1891	Out from Apr. 22, 1893, to Feb. 1, 1894.
Swedburg, Alfred W. ....	Nov. 30, 1895	
Sweet, Stella .....	June 9, 1893	
Swingle, Deane B. ....	May 9, 1900	
Swingle, Walter T. ....	Mar. 30, 1891	
Tait, Clarence E. ....	Nov. 15, 1899	
Talbot, William N. ....	Dec. 6, 1893	
Tastet, Waldo F. ....	Apr. 6, 1900	
Taylor, William A. ....	Feb. 24, 1891	
Taylor, William E. ....	Dec. 8, 1893	
Teele, Ray P. ....	June 15, 1899	
Temple, H. Inez .....	Jan. 25, 1898	
Thackaberry, Joseph .....	Apr. 12, 1899	
Thomas, Charlotte R. ....	Feb. 7, 1889	Out from Oct. 15, 1893, to Aug. 9, 1897.
Thomas, Robert H. ....	Apr. 7, 1892	Out from May 3, 1893, to Mar. 1, 1898.
Thompson, Emma S. ....	Aug. 31, 1896	
Thompson, Harry .....	Mar. 31, 1899	
Thompson, Harry Q. ....	Jan. 24, 1898	
Thompson, James H. ....	Nov. 28, 1893	
Thompson, Robert E. L. ....	July 1, 1893	
Thorn, Margaret E. ....	Jan. 9, 1888	
Thornton, S. Edwin .....	Mar. 23, 1896	
Thurber, Emma F. ....	Oct. 4, 1892	Out from Apr. 22, 1893, to Feb. 25, 1898.
Timberlake, Wyatt F. ....	Apr. 13, 1900	
Timmons, William H. ....	May 8, 1893	
Tinney, Virginia .....	Aug. 24, 1898	
Tippett, William T. ....	Nov. 23, 1895	
Tomlinson, William F. ....	Aug. 22, 1893	
Torrence, Emma I. ....	Sept. 2, 1893	
Totten, George E. ....	July 1, 1899	
Toumey, James W. ....	Apr. 7, 1899	
Tourtellotte, S. H. ....	June 15, 1891	Out from Apr. 18, 1893, to Jan. 5, 1898.
Towers, Cornelius W. ....	May 19, 1897	
Townsend, Norris L. ....	June 8, 1900	
Tracy, Samuel M. ....	Mar. 13, 1891	
Tracy, Will W., jr. ....	Sept. 21, 1896	
Trainer, John .....	July 5, 1893	
Treacy, Robert H. ....	Sept. 28, 1896	
Trescott, Thomas C. ....	Dec. 1, 1881	
Trice, Taylor .....	July 1, 1889	
Troughton, Joseph E. ....	Nov. 30, 1892	
True, Alfred C. ....	Mar. 2, 1889	
Tuck, Richard W. ....	Apr. 9, 1898	
Tull, Ava J. ....	July 31, 1900	
Tully, Josephine C. ....	Dec. 22, 1897	
Tully, Katherine .....	Feb. 23, 1895	
Tunstall, Jennie .....	Aug. 15, 1893	
Turnbull, Robert .....	Feb. 13, 1900	
Turner, Joseph J. ....	May 20, 1896	
Turner, Joseph M. ....	Mar. 3, 1896	
Tyson, Fannie .....	May 31, 1899	
Upton, Gertrude E. ....	Mar. 30, 1900	
Upton, Wallace L. ....	Sept. 15, 1899	
Vail, Homer W. ....	Jan. 6, 1898	
Valentine, Samuel I. ....	Oct. 12, 1894	
Vance, Isaac N. ....	May 25, 1895	
Vandervoort, Charles. ....	May 8, 1893	
Varela, Arthur G. ....	June 30, 1900	
Voigt, Fritz .....	June 27, 1899	
Volgenan, Ernest L. ....	Nov. 19, 1895	
Von Dorn, Calvin W. ....	Apr. 5, 1898	
Von Schrenk, Herman. ....	June 30, 1899	
Wade, Thomas J. ....	Aug. 6, 1891	
Wade, William H. ....	Dec. 16, 1887	Out from Nov. 15, 1888, to Mar. 9, 1893.
Wagner, Albert E. ....	Apr. 27, 1894	
Wagner, Frelinghuysen H. ....	Aug. 16, 1892	Out from July 31, 1894, to Apr. 16, 1898.
Wainwright, Helen S. ....	July 20, 1892	Out from May 23, 1893, to Sept. 19, 1897.

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau)  
July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Waite, Merton B.....	Nov. 1, 1888	
Walden, Celena.....	Aug. 5, 1881	
Waldo, Clara M.....	Jan. 29, 1898	
Wallace, Archibald H.....	Feb. 14, 1899	
Waller, Harry N.....	Mar. 25, 1895	
Waller, Osmer L.....	Jan. 17, 1900	
Walsh, Richard.....	May 26, 1894	
Walsh, Walter.....	May 16, 1893	
Walter, Harry K.....	Jan. 3, 1900	
Walter, Henry S.....	June 30, 1883	
Walter, Robert B.....	Aug. 25, 1899	
Walter, William L.....	Jan. 21, 1886	Out from Feb. 23, 1888, to May 15, 1905.
Walters, Mildred E.....	Nov. 17, 1896	
Wampler, James W.....	Oct. 30, 1893	
Wanstall, Harriet A.....	Jan. 18, 1899	
Ward, Carlotta L.....	Apr. 22, 1894	
Ward, Edward K.....	May 25, 1900	
Ward, George W.....	Mar. 9, 1891	
Ward, Marie J.....	Jan. 18, 1898	
Warner, George D.....	Nov. 12, 1895	
Warner, Marjorie F.....	May 21, 1900	
Wasdon, Benjamin D.....	Dec. 29, 1896	
Washburn, Henry J.....	May 16, 1898	
Waterman, Frederick D.....	June 24, 1895	
Watkeys, Alice M.....	Nov. 16, 1892	Out from July 15, 1893, to Apr. 11, 1898.
Watson, Arda.....	Aug. 15, 1893	
Watson, Samuel E.....	May 29, 1899	
Webber, Herbert J.....	Sept. 15, 1892	
Webster, John H.....	Feb. 21, 1896	
Webster, Nimia.....	Sept. 22, 1893	
Weidman, Charles S.....	Aug. 18, 1894	
Welland, Katherine A.....	Dec. 8, 1894	
Weller, Hiram B.....	July 23, 1891	Out from July 15, 1893, to June 27, 1895.
Wells, Carrie.....	Nov. 16, 1892	
Wells, Eliza M.....	July 2, 1898	
Wende, Bernard P.....	Aug. 30, 1893	
Werther, Clara.....	Aug. 27, 1891	
West, Laomer.....	May 20, 1896	
Wharton, John J.....	July 8, 1893	
Wharton, Virginia K.....	Oct. 2, 1882	Out from Nov. 2, 1895, to Nov. 21, 1896.
Wheeler, D. N.....	Mar. 5, 1898	
White, Bartholomew C.....	Sept. 26, 1899	
White, Thomas A.....	June 17, 1895	
Whitney, Milton.....	Nov. 30, 1891	
Whittaker, Ella E.....	Dec. 18, 1897	
Whittaker, Sylvia M.....	Apr. 16, 1898	
Whittemore, Sarah A.....	Oct. 27, 1897	
Whittleton, Robert J.....	July 1, 1889	Out from Mar. 31, 1893, to July 1, 1897.
Wiggin, Edward.....	Jan. 6, 1898	
Wight, Alexander E.....	Dec. 8, 1898	
Wight, John C.....	July 1, 1884	
Wight, William F.....	June 20, 1899	
Wilcox, Della E.....	July 1, 1891	
Wilcox, Earley V.....	Feb. 20, 1899	
Wiley, Harvey W.....	Apr. 9, 1883	
Williams, Etta L.....	Oct. 28, 1891	
Williams, Harvey D.....	June 22, 1895	
Williams, Howard H.....	Sept. 16, 1897	
Williams, Joseph.....	May 21, 1883	
Williams, Louis S.....	Aug. 20, 1890	Out from July 28, 1894, to Oct. 16, 1894.
Williams, Marion.....	Aug. 28, 1893	
Williams, Mary E.....	Jan. 22, 1898	
Willis, Edna L.....	Apr. 16, 1898	
Wilson, Jasper A.....	Dec. 28, 1898	
Willson, Adelyn R.....	Feb. 7, 1893	
Wilson, James.....	Mar. 5, 1897	
Wilson, Louise E.....	Jan. 14, 1892	Out from Aug. 31, 1893, to Aug. 17, 1897.
Winckelmann, Henry.....	Dec. 2, 1892	
Winchester, Bonnie.....	May 19, 1893	
Winfield, Alice M.....	Sept. 1, 1882	
Winnie, David A.....	Apr. 3, 1893	
Wisdom, Martha L.....	Sept. 28, 1893	
Withers, William A.....	June 24, 1895	Out from June 30, 1902, to July 1, 1905.
Wolf, Max.....	Aug. 15, 1893	
Wood, George W.....	June 22, 1895	
Wood, Maria L.....	Dec. 1, 1881	Out from Apr. 24, 1882, to Aug. 1, 1882.
Wooden, Morris.....	Sept. 5, 1895	
Woods, Albert F.....	Dec. 14, 1893	
Woods, Charles D.....	Nov. 22, 1894	
Woodson, Fannie B.....	Sept. 20, 1893	



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Woolfolk, George H.....	Feb. 21, 1896	Out from May 9, 1885, to Aug. 1, 1885; out from June 30, 1886, to Aug. 27, 1886; out from Mar. 31, 1888, to Aug. 1, 1890.
Woolsey, Theodore S., jr.....	June 16, 1900	
Workheiser, Henry F. R.....	June 21, 1899	
Wray, W. H.....	July 16, 1884	
Wright, Annette M.....	July 16, 1889	
Wright, John B.....	Apr. 9, 1898	
Wright, May H.....	Mar. 31, 1898	
Wyatt, Emma M.....	July 25, 1892	
Yenner, William.....	May 16, 1898	
Yerby, Everett D.....	Sept. 7, 1882	
Young, Florence I.....	Oct. 8, 1894	
Young, George D.....	Mar. 8, 1898	
Zappone, Almerico.....	Sept. 7, 1882	
Zimmerman, Anna.....	Feb. 7, 1895	
Zink, Charles H.....	May 21, 1896	
Zuendell, Theodore.....	June 16, 1891	

*Employees in the Weather Bureau of the Department of Agriculture July 1, 1906, whose appointment precedes July 2, 1900.*

[In the "Remarks" column "out" means out of the service of the Department.]

Name.	Date appointed.	Remarks.
Abbe, Cleveland.....	Jan. 3, 1871	Out from Jan. 21, 1877, to Mar. 16, 1881.
Alexander, William H.....	July 6, 1898	
Allen, George.....	Jan. 20, 1872	
Allen, Robert G.....	Oct. 18, 1887	
Alps, Henry F.....	July 25, 1898	Out from Dec. 18, 1890, to May 12, 1891.
Ashton, Clinton J.....	Oct. 25, 1881	
Ashton, John C.....	June 14, 1878	
Adie, Charles.....	Mar. 18, 1889	
Aliciatore, Henry F.....	Dec. 1, 1886	Out from July 1, 1894, to June 30, 1898; out from Nov. 8, 1898, to Dec. 7, 1898.
Ashenberger, Albert.....	Nov. 8, 1889	
Ashley, Alex McC.....	June 18, 1895	
Bacon, Samuel, jr.....	Mar. 8, 1890	
Bailey, Wayland.....	Aug. 9, 1884	Out from Aug. 31, 1895, to Mar. 14, 1898.
Baldwin, Harrison McP.....	June 3, 1881	
Balster, John A.....	Sept. 8, 1897	
Bain, John J.....	July 1, 1891	
Bartlett, James L.....	Jan. 31, 1898	
Barwick, James A.....	Mar. 31, 1873	
Bassler, Simon S.....	Oct. 1, 1891	
Bate, Henry C.....	Sept. 16, 1886	
Bauer, Jacob W.....	July 23, 1883	
Beall, Samuel W.....	Sept. 25, 1871	
Beals, Edward A.....	Nov. 16, 1891	
Belden, William S.....	July 1, 1894	
Bell, Aaron H.....	Jan. 21, 1898	
Bell, William.....	June 4, 1880	
Bennett, Maitland C.....	July 13, 1883	
Bennett, Walter J.....	Apr. 2, 1900	
Berry, James.....	July 8, 1878	
Berry, William.....	Apr. 27, 1877	
Beuter, Sophie A.....	Jan. 7, 1888	
Bigelow, Frank H.....	Oct. 1, 1891	
Bily, Joseph, jr.....	July 18, 1899	
Blagden, John D.....	Feb. 13, 1888	
Blandford, Samuel N.....	Oct. 15, 1887	
Bliss, George S.....	May 10, 1898	
Blundon, Benjamin A.....	Mar. 5, 1878	
Blystone, Montello E.....	Jan. 25, 1890	
Blythe, William T.....	Feb. 9, 1870	
Bolton, Joseph P.....	May 7, 1885	
Bowie, Edward H.....	Dec. 16, 1891	
Boyer, Harry B.....	May 26, 1881	
Bradley, James A.....	June 26, 1891	
Brand, Albert.....	Aug. 6, 1889	
Brandenburg, Frederick H.....	Aug. 21, 1877	
Branaham, Edward A.....	Apr. 1, 1873	
Breadin, Richard.....	Apr. 11, 1893	
Bridges, Theodore L.....	June 4, 1888	
Bright, Charles B.....	June 23, 1896	

*Employees in the Weather Bureau of the Department of Agriculture July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Brist, Frederick W .....	Mar. 8, 1897	Out from Apr. 21, 1878, to Aug. 12, 1878; out from July 9, 1898, to Apr. 30, 1899.
Bronson, Byron H. ....	Nov. 1, 1883	
Brown, Daniel J. ....	Feb. 13, 1899	
Brown, Edward A. ....	Sept. 5, 1887	Out from Sept. 2, to Nov. 23, 1883.
Buell, Allen .....	Sept. 16, 1870	
Burn, Arthur A. ....	Feb. 24, 1899	
Burns, Alexander G. ....	Sept. 20, 1887	Out from Sept. 2, to Nov. 23, 1883.
Burns, William G. ....	Sept. 27, 1895	
Burrows, Alvin P. ....	June 20, 1898	
Burrows, Orville C. ....	July 1, 1894	Out from Sept. 2, to Nov. 23, 1883.
Byram, John W. ....	Sept. 2, 1878	
Calvert, Edward B. ....	Mar. 21, 1890	
Calvert, Samuel C. ....	Oct. 24, 1896	Out from Sept. 2, to Nov. 23, 1883.
Campfield, Louis M. ....	Sept. 1, 1891	
Carey, James .....	Aug. 28, 1895	
Carpenter, Ford A. ....	Feb. 2, 1833	Out from Sept. 2, to Nov. 23, 1883.
Carr, David H. ....	Mar. 20, 1896	
Carroll, Daniel J. ....	Mar. 3, 1879	
Carter, John S. ....	Jan. 21, 1899	Out from Sept. 2, to Nov. 23, 1883.
Cavanagh, William C. ....	July 1, 1891	
Chafee, Frank P. ....	Mar. 1, 1879	
Chambers, Charles W., jr. ....	May 9, 1896	Out from Sept. 2, to Nov. 23, 1883.
Chamberlin, Charles E. ....	June 29, 1898	
Chapman, Mattie H. ....	Nov. 14, 1888	
Chappel, George M. ....	Mar. 30, 1881	Out from Sept. 2, to Nov. 23, 1883.
Christman William W. ....	June 15, 1898	
Church, John P. ....	Feb. 25, 1882	
Clark, William F. ....	June 20, 1900	Out from Sept. 2, to Nov. 23, 1883.
Claveloux, Francis A. ....	July 9, 1878	
Cleaver, Frank M. ....	Aug. 7, 1878	
Cleveland, Luman N. ....	Feb. 16, 1894	Out from Sept. 2, to Nov. 23, 1883.
Cline, Isaac M. ....	July 7, 1882	
Cline, Joseph L. ....	Mar. 17, 1892	
Clough, Homer W. ....	Dec. 15, 1893	Out from Sept. 2, to Nov. 23, 1883.
Collins, James F. ....	Oct. 27, 1891	
Collins, Thomas S. ....	Sept. 4, 1872	
Conger, Norman B. ....	Aug. 28, 1878	Out from Sept. 2, to Nov. 23, 1883.
Connaroe, Henry .....	Aug. 20, 1897	
Connell, Maurice .....	Dec. 9, 1884	
Connor, Patrick .....	Mar. 4, 1876	Out from Sept. 2, to Nov. 23, 1883.
Conrad, Frederick W. ....	Nov. 10, 1871	
Considine, Thomas J. ....	Nov. 1, 1883	
Conway, Margaret E. ....	July 1, 1891	Out from Sept. 2, to Nov. 23, 1883.
Cook, James R. ....	Mar. 28, 1894	
Cooke, Mortimer M. ....	May 6, 1898	
Cooper, Robert S. ....	June 20, 1896	Out from Sept. 2, to Nov. 23, 1883.
Cover, Louis C. ....	Dec. 9, 1891	
Cox, Henry J. ....	Aug. 1, 1884	
Craig, John .....	Oct. 20, 1873	Out from Sept. 2, to Nov. 23, 1883.
Crawford, Thomas. ....	Apr. 30, 1890	
Cronk, James W. ....	Oct. 10, 1887	
Crosby, Arthur W. ....	Dec. 27, 1890	Out from Sept. 2, to Nov. 23, 1883.
Cunningham, Mable M. ....	Feb. 23, 1899	
Currier, William S. ....	Aug. 2, 1887	
Cuthbertson, David. ....	Nov. 16, 1872	Out from Sept. 2, to Nov. 23, 1883.
Daingerfield, Lawrence H. ....	Mar. 4, 1898	
Davis, Albert J. ....	Apr. 20, 1881	
Davis, T. Frederick. ....	Apr. 7, 1899	Out from Sept. 2, to Nov. 23, 1883.
Davis, William .....	June 2, 1877	
Day, Preston C. ....	June 29, 1883	
Day, Walcott L. ....	Oct. 20, 1883	Out from Sept. 2, to Nov. 23, 1883.
Dean, Robert H. ....	Jan. 15, 1892	
De Graw, Paul. ....	Dec. 30, 1897	
Demain, Edward R. ....	July 17, 1880	Out from Sept. 2, to Nov. 23, 1883.
Donson, Lee A. ....	Apr. 9, 1888	
Dey, Laura M. ....	Jan. 15, 1897	
Dey, Luther M., jr. ....	Nov. 1, 1890	Out from Sept. 2, to Nov. 23, 1883.
Dey, Luther M., sr. ....	Nov. 20, 1874	
Devereaux, William C. ....	May 15, 1900	
Dick, Harvey B. ....	Mar. 18, 1886	Out from Sept. 2, to Nov. 23, 1883.
Diehl, Geneva B. ....	July 1, 1887	
Diggs, Fant .....	Sept. 14, 1898	
Dill, Charles .....	Mar. 9, 1897	Out from Sept. 2, to Nov. 23, 1883.
Dillon, Edward .....	Oct. 22, 1881	
Doherty, Cornelius .....	Oct. 14, 1889	
Donaldson, William E. ....	Jan. 30, 1890	Out from Sept. 2, to Nov. 23, 1883.
Dorman, Louis. ....	Oct. 6, 1880	

Out from Oct. 6, 1885, to Sept. 22, 1886; out from Oct. 20, 1889, to Mar. 25, 1890.

*Employees in the Weather Bureau of the Department of Agriculture July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Dorr, Howard M.	Nov. 28, 1898	
Dosher, John J.	June 2, 1894	
Dosher, Samuel L.	May 11, 1883	
Dudley, William M.	Aug. 9, 1890	
Easton, Edward C.	Feb. 16, 1889	
Eddey, George W.	Jan. 15, 1887	
Eddy, Nathan S.	Oct. 5, 1875	
Edwards, Rowena A.	July 1, 1898	
Eichelberger, Thomas H.	Nov. 29, 1898	
Emery, Eben H.	July 30, 1884	
Emery, Frank D.	June 5, 1899	
Emery, Samuel C.	Apr. 9, 1873	
Emigh, Eugene D.	May 31, 1898	
Emmons, Lucius H.	May 21, 1898	
Evans, Edward A.	Dec. 16, 1879	
Estes, Samuel B.	Mar. 8, 1893	
Fallon, William H.	Sept. 8, 1880	
Farrington, William H.	Aug. 2, 1875	
Fassig, Oliver L.	Jan. 12, 1883	
Felger, George W.	Sept. 4, 1874	
Fisher, David	Nov. 30, 1880	
Fitzgerald, John	May 20, 1874	
Foy, John T.	July 8, 1878	
Fraber, John W.	Feb. 9, 1870	
Francis, Fred L.	Sept. 13, 1893	
Frankenfield, Harry C.	Jan. 4, 1882	
Franklin, George E.	July 5, 1878	
Freas, Howard E.	July 1, 1894	
Fry, John C.	Sept. 22, 1891	
Fuller, William D.	May 26, 1898	
Fulton, Weston M.	Jan. 26, 1893	
Gardiner, I. Gwynn	May 19, 1885	
Garriott, Edward B.	May 18, 1874	Out from Jan. 1, 1884, to Mar. 11, 1884.
Garrett, Charles C.	Sept. 16, 1898	
Gaskins, William H.	July 1, 1893	
Geddings, Richard M.	July 29, 1881	Out from Feb. 1, 1885, to Aug. 2, 1885; out from Aug. 13, 1893, to Jan. 11, 1899.
Geren, Harry O.	July 28, 1899	
Gibson, Thomas	May 16, 1874	
Gillam, Frank	Aug. 17, 1880	Out from Jan. 16, 1881, to Oct. 31, 1881.
Glass, Elvin J.	Jan. 20, 1882	
Glenn, Samuel W.	Oct. 1, 1877	
Gosewisch, Frederic Z.	Feb. 29, 1872	
Goucher, Henry	Jan. 15, 1886	
Grant, Charles C.	Jan. 1, 1899	
Grant, Robert Q.	July 23, 1883	
Grasse, Herchmer W.	Dec. 24, 1890	Out from Sept. 17, 1891, to Nov. 15, 1891.
Gray, James J.	Nov. 20, 1885	
Green, William B.	May 29, 1889	
Gresham, Samuel P.	Nov. 24, 1887	
Grimes, George E.	Jan. 22, 1887	
Groene, Ernest F.	Oct. 30, 1896	
Grover, John	Mar. 13, 1880	
Grunow, Dexter C.	Feb. 24, 1898	
Guthrie, Leon J.	July 1, 1894	
Hackett, Arthur E.	July 9, 1889	
Harn, George U., jr.	June 6, 1896	
Hardin, Hal P.	Dec. 28, 1886	
Hardinge, Robert M.	July 2, 1885	
Hartwig, Walter C.	June 19, 1899	
Hass-Hagen, George	Jan. 7, 1878	
Hawkins, Laura F.	Jan. 19, 1893	
Hayes, Michael	Oct. 27, 1880	
Hayes, Montrose W.	Mar. 23, 1892	
Hayden, Julius C.	Dec. 31, 1889	
Haynes, John M.	Nov. 17, 1899	
Hazen, John S.	Aug. 17, 1889	
Heck, George J.	Jan. 12, 1882	
Heiskell, Henry L.	June 9, 1877	
Henry, Alfred J.	July 12, 1878	
Hercus, Alice T.	Jan. 3, 1887	
Hersey, Henry B.	June 29, 1883	
Hesse, Conrad E.	Oct. 22, 1896	
Hoagland, Annie E.	Apr. 29, 1889	
Hobbs, Everett C.	May 2, 1885	
Hobbs, Hermann E.	June 22, 1900	
Hackett, Sumner	Sept. 26, 1895	
Holcomb, Howard K.	July 6, 1898	
Holmes, Charles	Oct. 3, 1873	Out from Nov. 16, 1899, to July 15, 1900.
Hooper, John K.	Mar. 14, 1898	
Hotze, Ruby S.	Oct. 18, 1890	
Howard, Samuel M.	Apr. 1, 1896	



*Employees in the Weather Bureau of the Department of Agriculture July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Howe, Henry C. ....	July 29, 1890	
Hughes, Everett H. ....	June 14, 1897	
Hunt, George E. ....	Jan. 27, 1882	Out from Aug. 22, 1885, to Apr. 25, 1888.
Hurley, John F. ....	June 27, 1896	
Husson, William M. ....	Aug. 5, 1890	
Hyatt, Robert J. ....	Aug. 27, 1880	
Hyle, Charles A. ....	Mar. 29, 1898	
Jennings, Throp B. ....	Oct. 20, 1871	
Jermin, Frank. ....	July 1, 1894	
Jesunofsky, Lewis M. ....	Jan. 21, 1875	
Jones, Charles J. ....	July 1, 1891	
Johnson, Enoch G. ....	July 17, 1882	
Jones, Edward P. ....	Oct. 11, 1883	
Jones, James. ....	May 9, 1898	
Jones, Jesse. ....	Jan. 2, 1897	
Jones, John H. ....	May 8, 1879	
Johnson, Hiram. ....	Mar. 8, 1893	
Judkins, Levi A. ....	Mar. 10, 1890	
Kannowoski, Paul E. ....	Mar. 16, 1898	
Keller, David. ....	Jan. 31, 1890	
Kelliher, John J. ....	Apr. 26, 1890	
Kenealy, James. ....	June 24, 1876	
Keough, William. ....	Feb. 1, 1873	
Kimball, Herbert H. ....	July 30, 1884	
Kimball, James H. ....	Aug. 31, 1895	
King, Thomas H. ....	Aug. 1, 1882	Out from Aug. 9, 1895, to July 6, 1896.
Kinnear, Aaron H. ....	May 18, 1874	
Lane, Nathan D. ....	Aug. 11, 1871	Out from Aug. 11, 1876, to Feb. 28, 1879.
Larcombe, Benjamin F. ....	Sept. 29, 1883	
Lawton, George E. ....	May 2, 1885	
Lazenby, Richard O. ....	May 27, 1886	
Lee, Plato T. ....	Aug. 14, 1891	
Legler, Hugo. ....	June 21, 1900	
Ling, Charles W. ....	Aug. 27, 1884	Out from July 17, 1888, to Feb. 3, 1889.
Linney, Charles E. ....	Apr. 22, 1890	
Linsley, Julius G. ....	Feb. 1, 1878	
Lodholz, Louis. ....	Mar. 14, 1899	
Lomax, Amanda. ....	Sept. 15, 1900	
Long, Francis. ....	Aug. 1, 1884	
Long, Mary. ....	Aug. 26, 1893	
Long, Samuel C. ....	Dec. 4, 1900	
Lopez, Joseph. ....	Oct. 4, 1898	
Loveland, George A. ....	July 6, 1882	
Lovett, George L. ....	May 11, 1897	
Magrum, Albert F. ....	Feb. 5, 1897	
Mahany, Matthew. ....	July 1, 1891	
Marbury, John B. ....	Dec. 16, 1879	
Marean, Delzene. ....	Aug. 25, 1890	
Marean, Ralph B. ....	July 1, 1891	
Maring, Delos T. ....	Jan. 16, 1884	
Marvin, Charles F. ....	Sept. 1, 1881	
Mattison, Edward M. ....	Dec. 25, 1874	Out from June 8, 1876, to Nov. 13, 1878.
Maxwell, William D. ....	July 10, 1878	
Merrill, Herbert C. ....	Feb. 15, 1897	
Meston, Robert D. ....	Mar. 5, 1872	
Meston, James H. ....	Feb. 1, 1878	
Miller, Robert L. ....	Jan. 27, 1900	
Minehart, Elmo M. ....	Nov. 17, 1899	
Minnick, S. Percy. ....	Oct. 19, 1892	
Mitchell, Alexander J. ....	Jan. 3, 1882	
Mitchell, William A. ....	July 16, 1898	
Moore, Willis L. ....	Apr. 21, 1876	
Moore, Theodore T. ....	July 3, 1878	
Monroe, Joseph U. ....	June 16, 1891	
Montgomery, Frank. ....	Aug. 23, 1899	
Morton, Robert H. ....	June 1, 1892	
Mosby, Samuel L. ....	Nov. 1, 1887	
Murdock, Lester H. ....	May 21, 1891	
Murphy, Daniel C. ....	Nov. 9, 1871	Out from Nov. 10, 1876, to Jan. 10, 1877.
McAdie, Alexander G. ....	Jan. 4, 1882	Out from June 12, 1888, to Dec. 11, 1890.
McCallum, Daniel. ....	Feb. 7, 1899	
McCallum, Daniel P. ....	Sept. 20, 1890	
McDermott, Edward. ....	May 2, 1871	Out from Apr. 16, 1894, to Apr. 4, 1897.
McDonough, Patrick. ....	Dec. 27, 1886	
McGann, Edward W. ....	Feb. 29, 1872	
McGuiness, William C. ....	Jan. 2, 1890	
McLane, William, jr. ....	May 12, 1900	
McLean, John J. ....	Dec. 15, 1877	
McLeary, Frank E. ....	Sept. 10, 1898	
Niefert, William W. ....	Nov. 27, 1885	
Newman, Fitzhugh. ....	Apr. 9, 1881	
Newson, John F. ....	Apr. 8, 1891	

*Employees in the Weather Bureau of the Department of Agriculture July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Nichols, Augustus B. ....	Jan. 25, 1899	Out from Feb. 21, 1900, to Feb. 1, 1901.
Nichols, Esek S. ....	Feb. 23, 1899	
Nichols, John F. ....	Sept. 19, 1898	
Nimmo, E. Herbert. ....	Aug. 4, 1891	Out from Aug. 22, 1898, to Jan. 22, 1899.
Noyes, G. Harold. ....	Mar. 14, 1898	
Nunn, Roscoe. ....	July 1, 1891	
Oberholzer, George R. ....	Mar. 12, 1896	Out from Sept. 1, 1891, to June 9, 1892.
O'Connor, Gerald J. ....	Jan. 2, 1890	
O'Donnell, John J. ....	Oct. 18, 1886	
Olds, William J. ....	Jan. 20, 1885	Out from Aug. 12, 1886, to Jan. 10, 1887; out from Aug. 1, 1890, to June 15, 1891.
O'Neil, Daniel F. ....	Dec. 13, 1887	
Outrom, Thomas F. ....	Sept. 30, 1891	
Pague, Bemer S. ....	July 1, 1891	Out from Sept. —, 1891, to Dec. 26, 1893.
Palmer, Walter S. ....	Jan. 2, 1895	
Parker, Orin. ....	July 1, 1891	
Parker, William N. ....	July 16, 1897	Out from Aug. 12, 1886, to Jan. 10, 1887; out from Aug. 1, 1890, to June 15, 1891.
Passailaigue, Louis F. ....	July 10, 1883	
Patrick, Henry R. ....	Jan. 5, 1886	
Patrick, William. ....	Aug. —, 1871	Out from Aug. 6, 1876, to Mar. 4, 1880.
Payne, Lucy. ....	Mar. 8, 1893	
Pennywitt, Henry. ....	Feb. 17, 1874	
Penrod, Hiram J. ....	Mar. 4, 1871	Out from Sept. 27, 1874, to Jan. 6, 1875; out from Aug. 1, 1890, to June 15, 1891; out from Apr. 6, 1893, to Feb. 29, 1896.
Perls, Herman. ....	Feb. 15, 1894	
Peticolas, Virginia M. ....	Sept. 16, 1887	
Phillips, William F. R. ....	July 6, 1883	Out from Mar. 1, 1883, to Dec. 5, 1883.
Piercy, Joseph C. ....	Oct. 14, 1880	
Pindell, Lewis M. ....	May 18, 1878	
Plummer, William. ....	Feb. 1, 1883	Out from Jan. 25, 1884, to Oct. 8, 1884.
Pollock, Rosswitte E. ....	Nov. 8, 1894	
Powell, Robert B. ....	July 6, 1895	
Porter, William D. ....	Nov. 14, 1889	Out from Sept. 30, 1893, to June 1, 1898.
Potter, Samuel A. ....	Feb. 11, 1888	
Pugh, Thomas O. ....	Dec. 8, 1881	
Pursell, Ulysses G. ....	July 9, 1885	Out from Jan. 5, 1883, to Dec. 22, 1886.
Randall, Albert V. ....	June 13, 1892	
Randolph, Frederick J. ....	Jan. 6, 1879	
Rauch, Gustav E. ....	Mar. 6, 1900	Out from July 12, 1885, to Sept. 24, 1886.
Reed, Charles D. ....	Feb. 14, 1899	
Reed, William F. ....	Aug. 14, 1891	
Reed, William J. ....	Sept. 13, 1892	Out from Jan. 5, 1883, to Dec. 22, 1886.
Reeder, George. ....	Dec. 16, 1885	
Reynick, Alexander. ....	Feb. 16, 1899	
Rice, Frederick. ....	June 1, 1892	Out from Jan. 5, 1883, to Dec. 22, 1886.
Richards, Edward B. ....	Mar. 13, 1888	
Richardson, Charles H. ....	Nov. 1, 1890	
Richardson, Herbert W. ....	Jan. 19, 1886	Out from Jan. 5, 1883, to Dec. 22, 1886.
Ridgway, Frank. ....	Jan. 25, 1879	
Robbins, Millard V. ....	June 11, 1898	
Roberts, Orris W. ....	Aug. 1, 1898	Out from Jan. 5, 1883, to Dec. 22, 1886.
Robinson, Jesse H. ....	Mar. 6, 1872	
Robinson, Milton A. ....	Sept. 1, 1899	
Roche, Henry H. ....	Dec. 24, 1886	Out from Jan. 5, 1883, to Dec. 22, 1886.
Rohrer, Charles W. ....	June 19, 1899	
Root, Clarence J. ....	Feb. 14, 1900	
Ross, Ida. ....	Mar. 7, 1898	Out from Jan. 5, 1883, to Dec. 22, 1886.
Row, Edwin E. ....	Oct. 9, 1891	
Rupert, Fred J. ....	Feb. 18, 1892	
Ryker, John N. ....	July 7, 1882	Out from Jan. 5, 1883, to Dec. 22, 1886.
Sage, John R. ....	Apr. 3, 1897	
Salisbury, George N. ....	July 3, 1883	
Sanford, Morgan R. ....	Sept. 19, 1898	Out from Jan. 5, 1883, to Dec. 22, 1886.
Sartz, Richard S. M. ....	Mar. 28, 1898	
Scarr, James H. ....	May 3, 1898	
Schaeffer, John W. ....	Oct. 24, 1887	Out from Jan. 5, 1883, to Dec. 22, 1886.
Schlomer, William B. ....	Dec. 1, 1891	
Schneider, Charles F. ....	Dec. 28, 1885	
Scholl, Walter H. ....	Nov. 22, 1887	Out from Jan. 5, 1883, to Dec. 22, 1886.
Schoppe, William J. A. ....	May 16, 1898	
Scott, George W. ....	Jan. 2, 1878	
Sealey, Dewey A. ....	Aug. 20, 1898	Out from Jan. 5, 1883, to Dec. 22, 1886.
Seyboth, Robert. ....	Oct. 21, 1870	
Sharp, Stewart S. ....	July 3, 1897	
Shaw, William A. ....	Oct. 30, 1888	Out from Jan. 5, 1883, to Dec. 22, 1886.
Sherier, Julius M. ....	Nov. 2, 1885	
Shilling, Alphonso W. ....	Feb. 19, 1898	
Simmons, Homer H. ....	Dec. 18, 1899	Out from Jan. 5, 1883, to Dec. 22, 1886.
Simons, William U. ....	Apr. 30, 1872	
Simpson, Elmer E. ....	July 1, 1891	
Slaughter, J. Pemberton. ....	Aug. 17, 1883	

*Employees in the Weather Bureau of the Department of Agriculture July 1, 1906, whose appointment precedes July 2, 1900—Continued.*

Name.	Date appointed.	Remarks.
Sloan, Jay B. ....	Nov. 4, 1892	
Smith, George W. ....	July 8, 1878	
Smith, Herman W. ....	Oct. 21, 1887	
Smith, Horace E. ....	July 1, 1891	
Smith, James H. ....	Nov. 5, 1891	
Smith, John W. ....	June 12, 1874	
Smith, J. Warren. ....	Oct. 6, 1888	
Smith, Thomas G. ....	June 27, 1895	
Smyth, Patrick H. ....	Sept. 4, 1888	
Spencer, Eugene E. ....	Feb. 18, 1892	Out from May 31, 1902, to June 1, 1903.
Spencer, James H. ....	Jan. 9, 1895	
Stetson, Frank O. ....	Dec. 15, 1893	
Stewart, Charles. ....	June 30, 1883	
Stewart, Oscar D. ....	Sept. 4, 1878	
Stewart, John C. ....	Apr. 2, 1881	
Stewart, John S. ....	Mar. 17, 1898	
Stockman, William. ....	Dec. 11, 1877	
Strecker, Helen. ....	June 27, 1893	
Strong, Charles M. ....	Jan. 16, 1884	
Sullivan, John. ....	Jan. 22, 1882	
Sullivan, Richard H. ....	Sept. 24, 1887	
Summers, Melvin B. ....	May 4, 1900	
Sutton, Leon G. ....	Mar. 17, 1900	
Talman, Charles F. ....	Sept. 24, 1896	
Tait, Lemuel E. ....	Sept. 9, 1899	
Tarr, Leonard M. ....	July 3, 1883	Out from July 4, 1891, to Sept. 29, 1891.
Taylor, Nathaniel R. ....	Mar. 2, 1891	
Teepie, Arthur R. ....	Sept. 7, 1898	
Templeton, Clara A. ....	Aug. 24, 1899	
Thiessen, Alfred H. ....	June 20, 1898	
Thomas, George W. ....	Dec. 15, 1898	
Thompson, Arthur. ....	Aug. 20, 1885	
Thompson, Charles D. C. ....	Mar. 12, 1889	
Thompson, Edwin C. ....	July 16, 1884	
Thompson, E. Herbert. ....	Apr. 24, 1880	
Thompson, John L. ....	Sept. 16, 1895	
Thornton, Walter S. ....	May 23, 1891	Out from Aug. 1, 1895, to Feb. 14, 1896.
Tingley, Franklin G. ....	July 15, 1898	
Todd, George T. ....	Jan. 4, 1887	
Todd, Herbert G. ....	Jan. 28, 1897	
Tolman, Charles F. ....	Sept. 24, 1896	
Towner, Noble. ....	Dec. 7, 1894	
Townsend, Theodore F. ....	Mar. 1, 1871	
Tracy, William H. ....	Dec. 19, 1898	
Tuch, Charles B. ....	Apr. 11, 1879	
Vail, Herbert E. ....	Feb. 25, 1898	
Vanderpool, Jesse L. ....	July 1, 1892	
Van Vradenburg, Marion B. ....	Mar. 21, 1898	
Volker, Hermann. ....	Jan. 15, 1890	
Von Herman, Chas. F. ....	Nov. 17, 1884	
Von Ostermann, George F. ....	Feb. 7, 1899	
Vose, Elisha C. ....	Dec. 22, 1885	
Waldron, Bion L. ....	Jan. 3, 1890	
Walz, Ferdinand J. ....	May 12, 1885	
Watson, James M. ....	Apr. 2, 1870	
Watters, William H. ....	Mar. 17, 1898	
Weber, Clara. ....	July 1, 1891	
Weeks, John R. ....	Apr. 7, 1898	
Weels, Edward L. ....	Feb. 25, 1896	
Welsh, Lucius A. ....	Aug. 2, 1873	
Whedon, Charles T. ....	Sept. 27, 1897	
Whiteside, James L. ....	July 17, 1880	
Whitman, Ozias. ....	Mar. 17, 1892	
Widmeyer, James J. ....	Dec. 4, 1885	
Wiesner, Abe. ....	Apr. 2, 1900	
William, Frank T. ....	Apr. 25, 1881	
Williams, Henry E. ....	Mar. 24, 1876	
Williams, John R. ....	Oct. 7, 1872	
Williams, Robert C. ....	Feb. 1, 1885	
Willson, George H. ....	Apr. 24, 1880	
Willson, George N. ....	June 5, 1890	
Wilson, Joseph B. ....	July 25, 1889	
Wilson, Wilford M. ....	Sept. 25, 1885	
Winters, Louis. ....	July 12, 1887	
Wollaber, Arthur B. ....	Nov. 19, 1891	
Wood, Peter. ....	July 17, 1880	
Wright, Marsden. ....	Aug. 1, 1889	
Wurtz, George B. ....	June 18, 1890	
Young, R. Frank. ....	Jan. 6, 1888	





## REPORT ON NEW BUILDING OPERATIONS.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF CHAIRMAN OF BUILDING COMMITTEE,  
*Washington, D. C., September 29, 1906.*

SIR: I have the honor to submit herewith a brief statement covering the work for the past year on the building operations for the Department of Agriculture, authorized by the act of Congress approved February 9, 1903.

Respectfully,

B. T. GALLOWAY,  
*Chairman, Building Committee.*

HON. JAMES WILSON, *Secretary.*

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### SUPERVISION OF THE WORK.

The building work for the Department of Agriculture has continued in charge of the building committee appointed by the Secretary of Agriculture, which now consists of Mr. Gifford Pinchot, Forester of the Department, Dr. A. C. True, Director of the Office of Experiment Stations, and the writer, who, being designated as chairman of the committee, has in such capacity made all necessary recommendations, prepared requests for authorizations, requisitions, etc., and attended to the necessary details connected with the work. Mr. Pinchot was appointed a member of the committee to fill the vacancy caused by the resignation, on October 31, 1905, of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry.

The general construction work has been continued in charge of John Stephen Sewell, captain, Corps of Engineers, U. S. Army, and the mechanical equipment work in charge of Messrs. R. Barnard Talcott and S. Franklin Gardner, mechanical engineers, assisted by Mr. H. L. Gilbert, draftsman. Mr. J. G. Palmer, inspector, has been in immediate charge of the construction work under Captain Sewell, and has been assisted in the inspection work by Messrs. L. F. Eaton, H. W. Saunders, and R. L. Wallach. Mr. Saunders was appointed to fill the vacancy caused by the resignation of Mr. J. M. Thompson, and Mr. Wallach to take the place of Mr. L. B. Roberts, who also resigned during the year.

### GENERAL CONSTRUCTION WORK.

The general construction work, the contract for which, as stated in last year's report, was awarded on December 14, 1904, to Mr. Ambrose B. Stannard, of New York, who submitted the lowest of twenty bids

received, has been executed in a satisfactory manner, and the progress made has been good.

The work has now progressed, with the exception of the interior finish, to approximately the fourth-floor line, and it is probable that the roof will be on before the winter season. The roofing and closing in will allow the interior work to be carried on during the winter without interruption, which, without unforeseen complications, will insure the completion of operations within the contract time, namely, November 14, 1907. Difficulties have been experienced with the shipment of materials, the cutting of the ornamental stonework, and other details of the work, but with the efficient management of Captain Sewell and the assistance of the architects the matters have been adjusted and all serious delays have been eliminated.

#### MECHANICAL EQUIPMENT WORK.

On January 5, 1906, proposals were opened for the heating and ventilating and special piping systems, the electric wiring and conduit systems, and the electric passenger elevators. Nine proposals were opened for the heating and ventilating and special piping systems, the lowest bid received being that of Mr. Charles H. Sanborn, of Boston, Mass., amounting to \$80,285. For the electric wiring and conduit systems sixteen proposals were received, that of the Watson-Flagg Engineering Company, of New York, amounting to \$19,775, being the lowest; and the lowest of the two proposals received for the electric passenger elevators was submitted by the Otis Elevator Company, of New York, which, including an alternate proposal for an additional safety device, amounted to \$30,975. The building committee concurred in the recommendation of the mechanical engineers in the acceptance of the lowest bid received for each branch of the mechanical work, and the proposals as given above were accepted by the Secretary of Agriculture on January 16, 1906.

The heating and ventilating system, as under contract, is a hot-water indirect system, with direct radiators in toilet rooms and corridors only. The air before being introduced into the rooms is washed to eliminate all dirt and dust, and the supply to the rooms is to be automatically controlled to give the desired uniform temperature and good ventilation. The special piping work includes piping for cold water, hot water, distilled water, steam, gas, compressed air, and vacuum, having outlets in every room, and also drinking fountains with distilled water connections in the corridors, inlets for the vacuum cleaning system in each story, and gas piping for combination fixtures throughout the corridors. The work under the heating and ventilating and special piping contract was started in June, 1906, and is progressing in a satisfactory manner.

The electric wiring and conduit system includes conduit and wiring for a lighting system, consisting of ceiling and bracket outlets, and for two power outlets of 1-horsepower capacity in each room; and conduit for an intercommunicating telephone system having a wall and floor outlet in each room, for a clock system with an outlet in every room, and for a watchman's clock and a fire-alarm system with ten stations in each wing. The electric work was begun in April, 1906, and is about one-fifth completed.



Three electric elevators comprise the elevator equipment in each wing. Machines and motors for this equipment are under construction, and the work will be installed as soon as the building conditions will permit.

Sample appliances, shop drawings, etc., of the different branches of the mechanical work have been acted upon, and the entire work is progressing in a satisfactory manner.

The committee having decided that the power-plant appliances, including boilers, engines, generators, pumps, etc., should not be installed in the laboratory in order to avoid interference with the laboratory work by vibration, dirt, etc., sketch plans for a power house of a temporary nature, located at the rear of the laboratory, with tunnel connections, and for its equipment were prepared by the mechanical engineers. These sketches were approved by the building committee, and the working drawings for the power plant are now being prepared and will be put on the market during the coming winter, so that the work may be started in the early spring in time for its completion by the expiration of the contract time for the completion of the building operations.

The new 18-inch diameter sewer, extending from the building site to B street NW., the contract for which, as mentioned in the last report, was awarded to the R. J. Beall Construction Company, of Washington, D. C., which submitted the lowest of four bids received, amounting, based on actual quantities, to \$6,898.26, has been entirely completed, and the necessary connections therewith have been made.

#### FINANCIAL STATEMENT.

As stated in last year's report, the contract with Mr. Stannard, as accepted December 14, 1904, including the two alternate proposals, one for terra-cotta floor construction and other for the omission of all marble wainscoting in the corridors, amounted to \$1,171,000. By supplementary agreements enumerated below the amount of Mr. Stannard's contract now stands at \$1,178,238.88, as follows:

##### *Present status of general construction contract.*

December 14, 1904, total amount of original contract-----		\$1, 171, 000. 00
	Addition.	Deductions.
February 14, 1905, for changes in floor construction, cement, and granite work -----		\$14, 750. 00
June 26, 1905, additional excavating, concrete paving, etc-----	\$37, 511. 84	
October 20, 1905, omission of granite work and brickwork and for additional concrete footings-----		11, 132. 39
March 30, 1906, for increased cost in plumbing and shoring, omission of dry wells and area railings, and change in waste piping-----		4, 390. 57
Total -----	37, 511. 84	30, 272. 96
Net addition-----		7, 238. 88
Total amount of contract, September 15, 1906-----		1, 178, 238. 88

*Statement of account, new building fund, to September 15, 1906.*

Appropriations:	
March 3, 1903	\$250,000.00
March 3, 1905	700,000.00
June 30, 1906	300,000.00
Total	1,250,000.00
Expenditures:	
Salaries of supervising engineer, inspectors, mechanical engineers, etc	\$19,362.58
Authorizations for traveling and other miscellaneous expenses	1,305.71
Requisitions for supplies, etc	3,915.73
Contracts	618,170.50
Express charges and telegraph and telephone service	32.52
Total	642,787.04
Unexpended balance	607,212.96
Limit of authorized appropriations	1,500,000.00
Expenditures and liabilities:	
Salaries of supervising engineer, inspectors, mechanical engineers, etc	\$32,762.60
Authorizations for traveling and other miscellaneous expenses	1,461.56
Requisitions for supplies, etc	3,914.98
Contracts	1,375,033.21
Express charges and telegraph and telephone service	32.72
Total	1,413,205.07
Balance available	86,794.93

Since the passage of the act of February 9, 1903, authorizing the construction of the new quarters for the Department of Agriculture the growth of the Department has been very rapid. Within the three and one-half years that have elapsed since the bill was approved there has been an increase in the rented space occupied by the Department of over 99 per cent and an increase of the annual rentals of 150 per cent. The records will show that the present work has been economically performed and that as large an amount of space as is consistent with the needs and requirements of the Department has been secured.

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